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SAFAI MARGDARSHIKA

(A Guide Book on Sanitation)

Ishwarbhai Patel

Sub-Committee for Social Programmes
NATIONAL COMMITTEE FOR THE GANDHI CENTENARY
Rajghat, New Delhi-1

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SAFAI-MARG DARSHIKA

(A guide book on sanitation)

Ishwarbhai Patel

Principal

Safai Vidyalaya, Harijan Ashram, Ahmedabad-13

**SUB-COMMITTEE FOR SOCIAL PROGRAMMES
NATIONAL COMMITTEE FOR THE GANDHI CENTENARY
HARIJAN SEVAK SANGH, KINGSWAY, DELHI-9**

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FOREWORD

“Safai Marg Darshika”, published by the Social Programmes Sub-Committee of the National Committee for the Gandhi Centenary, will, without doubt, be immensely useful to the hundreds of workers engaged in the task of “Bhangi-Mukti” and “Bhangi-Kasht-Mukti”. This book will not only benefit those working in the field of sanitation and Harijan uplift, but will be a guide to those men and women also who are interested in these matters. This book is probably the first of its kind and as such has added significance. It will also prove useful to officers of the municipal and other health departments.

The Western countries have done a lot, towards the development, education and improvement of the modern science of health and sanitation. And now it has become a specific science. Though late, India is following and pursuing this subject in a new way. This book is a part of this science. It is true that, keeping in view the science of health and sanitation, the sanitary engineering has been presented in this book in a modulated and amended form according to the injunctions of Gandhiji and the requirements of the country. This has made the complexity of the subject rather very simple.

On the occasion of the Gandhi birth centenary we have chalked out some programmes for the removal of untouchability and improvement of economic and social conditions of our scavenger brethren. For the implementation of these pro-

grammes it is necessary that at least the custom of carrying faeces as head-load be completely abolished, the age old service latrines be converted into clean water-borne latrines and urinals and scavenging be not considered a hereditary profession of any one community. We must remember that cleanliness is next to Godliness.

—Sucheta Kripalani

PREFACE

Cleanliness is of prime importance both in our personal as well as social life. Life becomes pure by cleanliness. It is not proper to make any distinction between internal and external cleanliness. It will not do to have filth around us when our minds are clean and hearts are pure. Nor would it be proper to be conscious of personal and environmental cleanliness while allowing access to filthy thoughts in our minds. Therefore, as far as purity is concerned, it should be both internal as well as external.

No body likes filth wittingly. But laziness breeds the habit of evading cleanliness. Sometimes we get angry on seeing the surroundings filthy and say why it has not been cleaned. Since we do not hold ourselves responsible for that filth and our laziness prevents us from cleaning it, we throw the blame on some one else. It becomes a habit to make things dirty ourselves and let others clean it. This bad habit unwittingly pollutes our minds and we make our lives useless by depending upon others.

To hold the sweeper, the scavenger, the municipality and the State answerable for cleanliness is a crime against society. This individual and social negligence is responsible for the creation of the profession of "Bhangi" for removing excreta. He shall have to be delivered from this profession which he is obliged to adopt.

Gandhiji had deeply felt this burning national problem. He did not want any one community to continue to adopt this as a hereditary profession.

Had the individual, the society and the government understood the question of cleanliness properly and given

adequate thought to it, some solution would have emerged. But it did not happen. Proper attention to the question of cleanliness as of prime importance has not been given in the national projects. And whatever half-hearted thought was given, it was not brought into practice by several States and municipalities.

With the exception of a few big cities where sewage system exists, the condition of latrines in almost all parts of the country is very alarming and shameful too. Such hellish conditions cannot be tolerated for long. Therefore, attention must be paid towards the construction of sweeperless latrines like Septik Tank, Aqua Privy, Hand-flush etc. It is heartening to know that Gujarat, Kerala and Bihar have decided that new latrines should be sweeperless. State governments and municipal committees encourage people to convert dry-type latrines into sweeperless ones by giving loans and grants.

Keeping in view the aim of Bhangi-Mukti, Gandhi Smarak Nidhi and Harijan Sevak Sangh are running workers' camps at various places in the country where theoretical and practical training in this regard is imparted. Trained workers are also working towards this end in their respective areas.

It is a matter of satisfaction that the Social Programmes Sub-Committee of the Gandhi Centenary Committee has given adequate importance to the question of Bhangi-Mukti. This book, "Safai Marg Darshika", is being published by the above Sub-Committee. With a view to implementing the Bhangi Mukti programme, considerable information about the construction and working of several types of odourless latrines which are clean and free from flies and mosquitoes, has been provided in this book. It is hoped that this book will provide guidance not only to the workers but also to those who are interested in the question of "Bhangi-Mukti."

—Viyogi Hari

INTRODUCTION

“Bhangi” was considered to be the lowest in Society. The work which the scavenger had to do perforce was also considered to be unclean and low. The health and sanitation of the society depends upon the cleansing work. The “Bhangi” who renders this most important service to the society lives far away from the city or village in shacks in a congested Basti situated by the side of a stinking drain. He has not received any economic, social or educational facilities. Whatever facilities he got were of no avail to him because of his illiteracy and laziness. It is only in our country that a particular community is constrained to do the cleansing work. The society has even branded the “Safai” worker as an untouchable. The “Bhangi” has to perform this important task of the society forcibly under unhygienic conditions, with unscientific implements and in the face of being branded as an untouchable. Revered Bapu undertook the task of bringing about improvement in this work and deliverance to this community.

Considering this work as unclean and low, no other community took to it. How long can this evil system be tolerated in this era of science? There is great need for scientific implements in the “Safai” work which should be so improved that every body may be able to do it easily and it may not be left to any one community. “Bhangi-Mukti” will be possible only when the community which is forced to do it as an untouchable, abandons it to take up other sophisticated jobs. For the present, to provide some comfort to those who are doing this job under inhuman conditions, it is necessary to provide them with improved implements. The present-day method of carrying night-soil as head-load can be abolished for ever by constructing water-borne latrines.

So far, there had been no book on this topic for the guidance of the workers who come to the Safai Vidyalaya for training. Municipal committees and corporations also seek such literature. Keeping these facts in view, this book has been prepared. Illustrated information about the various improved implements in use throughout the process right from the latrine to the manure centre, is given in this book to show how the inhuman method of carrying night-soil as head-load may be abolished. Modest attempt has also been made to give illustrated information about the various types of clean latrines so that ordinary masons and workers may be able to understand their construction and scientific working and construct them according to local conditions. Although this book has been written with an eye towards the cities, some questions of rural importance have also been included in it.

I was entrusted with the task of preparing the "Safai Marg Darshika" by the Harijan Sevak Sangh. It is gratifying that it is being published by the Social Programmes Subcommittee of the National Committee for the Gandhi Centenary.

Shri Jiwanlal, Secretary, of the Harijan Sevak Sangh, has given an enlightening article on Bhangi-Mukti and Bhangi-Kasht-Mukti in this book. This will give further guidance to the workers on this topic.

I am grateful to many friends in the field of constructive work for their valuable help in the preparation of this book.

—Ishwarbhai Patel

BHANGI-KASHT-MUKTI AND BHANGI-MUKTI

[With a view to providing additional guidance to the workers engaged in "Harijan Sewa, we reproduce here an article on "Bhangi-Kasht-Mukti and Bhangi-Mukti" written by Shri Jiwanlalji, Secretary of the Harijan Sevak Sangh. This throws a significant light on this topic. The workers would get an insight into the problem of "Safai" workers and their task—

—Author]

Bhangis are the lowest among the low. The Scheduled Castes, in spite of the abolition of untouchability under Article 17 of the Constitution, still suffer from social disabilities in all provinces in one form or the other. The intensity of this stigma of course varies from province to province. The Commissioner for Scheduled Castes and Scheduled Tribes, in his report for 1965-66, while quoting numerous examples of various provinces, has enumerated cases of denials of admissions in schools, drawing water from public wells, entry in the hotels and restaurants, wearing of gold ornaments, taking out marriage procession with bride-groom on a horse-back, denial of common burial ground, keeping the Harijans away from barber and washermen shops etc. etc. But our Bhangi brothers and sisters are even discriminated against by other Scheduled Castes. At various places, they are denied social rights enjoyed by other Scheduled Castes.

The obvious reasons are that peculiar situation exists in India. Nowhere in the world this profession is confined to a particular caste as in India and that the job of a scavenger is considered as the meanest. In Gandhiji's words, "We have reduced them to the level of the beast. They earn a few coppers but only at the expense of their human dignity. The

weight of oppression has crushed them. It is enough to break one's heart to see them eating their food, covering under the shadow of the latrine wall."

Government of India, Ministry of Home Affairs, had appointed Scavenging Conditions Enquiry Committee, under the Chairmanship of Prof. N.R. Malkani, which in 1960, while submitting its recommendations has described the unbearable and inhuman working conditions of the scavengers. It says, "Even today, after 13 years of freedom, it is common sight to see a scavenger moving with a heavy load of night-soil on his head carried in a bamboo basket or a leaking drum, the matter trickling over his face and body. The passer by avoids his sight as he considers it inauspicious to meet with such a scene but gets reconciled to it as if it is inevitable. He perhaps does not trouble himself to arouse his conscience which is bound to tell him that such sights could be avoided and the scavengers made not to carry any head-loads of night-soil. If per chance, a scavenger comes in close proximity he is showered upon with all sorts of filthy remarks and so often with abuses. No sooner, a scavenger with a head load or a night-soil cart comes into sight, men start pulling out their handkerchiefs, the ladies the "pallas" of their sarees and cover their noses. Even the officers-in-charge of public health who are supposed to remain daily in close touch with the scavenging work and look after their welfare, for which they are paid, have been noticed drawing out their handkerchiefs and trying to remain as far away as they could, from the spots of filth, the spots where the scavenger is required to work for hours together day in and day out and for his whole life."

Bhangis, though called by various names in different provinces such as a *Mehtars*, *Chuhras*, *Balmikis* etc. prefer to be called as *Balmikis*. *Paky* in Andhra, *Dom* in Bihar, *Chakaliya* and *Thoti* in Kerala, *Adi-Andhra* and *Adi-Dravida* in Madras and Mysore are made to do the job of sweepers

and scavengers. The word 'Balmiki' covers up those communities which are engaged in scavenging and sweeping.

Untouchability is ages old. Some studies have come to the conclusion that this social disease is even pre-vedic. But the evidence hitherto collected shows that there were no professional scavengers before Mohammedan conquest. The Hindu social system, based on rural conditions, did not necessitate such sanitary service. Mohammedan kings and chiefs introduced this service as their women folk in Parda did not move out as others.

No definite conclusions have been drawn by research scholars but it is very likely that the Balmikis were Rajputs in those days who fought against the Mohmmedan invaders and fell captive. The conquerers compelled them to serve as scavengers for their families. This is partially borne out from the fact that in some provinces, the sub-castes of Balmikis are those of Rajputs.

The Scheduled Castes as per 1961 Census are 65 millions comprising 14.64% of the population. Among the workers 3,86,726 were engaged in scavenging and 4,15,417 as sweepers. The provincewise break up is given in the following table.

It is likely that there may have been an addition of about 1 lac scavengers during the last 7 years. We, therefore, presume that there are about 5 lacs of scavengers serving in 2200 municipalities.

Rural Areas

It is not that there are no Balmikis in rural areas. There, they are even more economically exploited and socially discriminated than those in urban areas. I have broadly dealt with those who either work or serve as sweepers and scavengers in urban areas. In rural areas we have to popularise the slogan of 'Tatti-par-Matti' (puttiug earth over the night-soil after easing). The trench latrines like Gopuri, Gasplant etc. can be advised in rural areas in addition to hand-flush latrines.

Provincewise List of
(According to
Scavengers)

S.No.	States	Male	Female	Male	Female
1.	Andhra Pradesh	1,739	1,090	4,693	3,314
2.	Assam	181	23	753	123
3.	Bihar	2,461	1,220	8,019	5,327
4.	Gujarat	2,826	1,154	8,813	6,548
5.	Jammu & Kashmir	197	5	69	21
6.	Kerala	115	33	815	528
7.	Madhya Pradesh	5,701	6,096	11,204	9,029
8.	Madras	3,965	861	11,633	6,601
9.	Maharashtra	1,369	1,076	9,262	7,877
10.	Mysore	905	542	8,298	4,225
11.	Orissa	1,281	1,710	2,161	2,333
12.	Punjab	15,582	27,365	15,122	10,750
13.	Rajasthan	11,321	13,107	7,665	7,178
14.	Uttar Pradesh	33,373	32,301	28,784	15,346
15.	West Bengal	1,438	317	4,723	2,070
16.	Delhi	843	643	9,063	2,255
17.	Himachal Pradesh	289	61	382	241
18.	Tripura	50	10	105	54
19.	Dadra Nagar Haveli	1	1	—	—
20.	Pondicherry	40	2	11	18
		83,677	87,626	1,31,575	83,848
Total (Male and Female)			1,71,303	2,15,423	
21.	Goa Daman Div				
22.	Laccadiv				
23.	Nagaland				
24.	NEFA				
25.	Andaman Nicobar				
26.	Manipur				

Sweepers and Scavengers
1961 Census)

			Sweepers	Total Scavengers and Sweepers
<i>Rural & Urban</i>		<i>Total</i>	<i>Rural & Urban</i>	<i>Rural & Urban</i>
<i>Male</i>	<i>Female</i>	<i>Male & Female</i>	<i>Male & Female</i>	<i>Male & Female</i>
6,432	4,413	10,845	33,038	43,883
934	146	1,080	5,938	7,018
10,480	6,547	17,027	20,403	37,430
11,639	7,702	19,341	15,770	35,111
266	26	292	4,938	5,230
930	571	1,501	14,241	15,742
16,905	15,125	32,030	26,690	58,720
15,598	7,462	23,060	15,458	38,518
10,631	8,953	19,584	52,951	72,535
9,203	4,767	13,970	16,204	30,174
3,442	4,043	7,485	—	6,573
30,704	38,115	68,819	35,635	1,04,454
18,986	20,285	39,271	11,561	50,832
62,157	47,647	1,09,804	1,09,602	2,19,406
6,161	2,387	8,548	40,395	48,943
9,906	2,898	12,804	11,676	24,480
671	302	973	103	1,076
155	64	219	78	297
1	1	2	11	13
51	20	71	725	796
2,15,252	1,71,474	3,86,726	4,15,417	8,01,231
				246
				14
				237
				194
				197
				217
				8,02,336

According to 1961 census 18% of the population is urban and the number of towns is 2690. The population-wise break up of the towns is as under :—

Over one lakh	50,000 to one lakh	20,000 to 50,000	10,000 to 20,000	5,000 to 10,000	less than 5,000
107	141	515	817	844	266

It will thus be seen that there are only 763 towns with population of 20,000 and above. Taking into consideration the limitations of the constructive organisations, it is desirable to select few municipalities with population ranging from 25,000 to one lakh as intensive blocks for implementation of both Bhangi Kasht Mukti and Bhangi Mukti programmes. Such towns can serve as good examples for the Government, Municipalities and the Society.

Bhangi Kasht Mukti is short term programme for transitional period to achieve the ultimate object of Bhangi Mukti. It implies bettering the working and living conditions of the scavengers to pull them out from the present degrading life.

Various aspects of their life enumerated below are to be touched to offer them relief. It is to be done though the fear involved is that they may be satisfied with few conveniences to continue this job and may not take the bold step of leaving this job for good and switch over to the non-caste based occupations.

(a) *Economic*—Injustice has been done to deny the sweepers and scavengers the protection under Industrial Disputes Act 1947 even though they are covered by the Trade Union Act of 1926, They have been denied the benefits of Factories Act 1948 and other Acts like workmen compensation Act and Employees Insurance Act etc. The Municipalities should, in this regard, be treated as Employers to make it a binding on them as is being done in other sectors. Taking

into consideration the nature of work of sweepers and scavengers, the normal hours of work should not be more than seven hours per day of which not more than four hours could be devoted to scavenging. The working hours of those who are exclusively employed as scavengers should not exceed five.

(b) *Wages, Provident Fund, Leave, Holidays etc.*—Sweepers and Scavengers should at least be treated as class IV servants though the filthy job they do, warrants better wages than class IV. The unfortunate fact today is that in various provinces they are being paid lesser than class IV. Their rules of appointment, confirmation, salary, provident fund, pensions, leave, holidays and uniforms etc. should be so framed as to bring them on par with class IV immediately without any further loss of time.

(c) *Co-operative Credit Societies*—The experience of the workers has been that majority of the sweepers and scavengers borrow loans from money-lenders on exorbitant rates of interest and fall into their clutches. Efforts will have to be made to educate them not to spend on wasteful items.

The legislation for redemption and reconciliation of debts be enacted as has been done for Scheduled Tribes in some States.

It should be the obligatory duty of the municipalities to sponsor co-operative credit societies where the employees are more than twenty. This will provide alternative agency for credit for purposeful expenditure. The experience of such societies in Bihar, Gujarat and Madras has been very encouraging. The social workers and trade unionists should extend their helping hand to accelerate the progress of this movement.

(d) *Prohibition*—The workers have to create public opinion for suitable legislation to stop the sale of liquor and other intoxicants. Weaker sections of the society are the

worst sufferers. They will have also to be educated on the evils of drinking.

(e) Stopping of traditional social customs of wasteful expenditure on marriage, deaths etc.

(f) *Family Planning*

In their economic uplift, the Trade Unions can play an important role. Active contacts of constructive organisations with Trade Unions are, therefore, desirable.

Living Conditions

(a) *Housing facilities*—Insignificant percentage of sweepers and scavengers has been provided with adequate housing accommodation. They, by and large, continue to live in huts far away from the site of work. It should be one of the obligatory functions of the municipalities as employers to provide service quarters to the the sweepers and scavengers. Better it would be if they are encouraged to build their own houses by grant of free plot of land and loan equal to 36 months salary. The benefits of low income group housing and co-operative housing schemes could also be made available to them. The formation of co-operative societies will enable them to own their houses as the service quarters of the municipality serve as a lever to pressurise them to continue to work as scavengers.

(b) Provision of Sanitary arrangements, road lights, drinking water etc. in the *batis*: The experience so far has been that majority of sweeper localities are not provided with these necessities of life. They, therefore, cannot keep themselves clean and their houses, streets and the locality worth living. The social workers and the trade unionists should prevail upon the municipalities to give priority to scavengers' localities in their schemes.

(c) Provision of community centres for cultural activities in the *bastis*: This helps them in get-to-gether in the evenings and offers them the facility of their welfare and uplift. Their children and youth could also use the premises.

Working Conditions

(a) Supply of better implements such as scrapers, buckets, wheel-barrows, hand gloves, rubber shoes etc. as recommended by Malkani Committee Report and accepted by the Government of India. (Gist of recommendations has been published by Harijan Sevak Sangh).

(b) Improvements in the latrines and providing receptacles as suggested by the above committee.

(c) Introduction of urban latrines (conservancy type) as designed by Central Public Health Engineering Organisation, Nagpur and published by Ministry of Health and Family Planning, New Delhi in 1966.

Bhangi Mukti

It is a revolutionary slogan and programme which envisages a society where a particular caste will not be compelled by circumstances to serve as scavengers. Broadly speaking, it means that the latrines will be all hand-flush and the services of no human-being will be required to remove the night-soil from the latrines. I have termed it as revolutionary and not only humanitarian as it aims at creating a society where the Balmikis will not be made to continue and follow their hereditary profession as the society has made them to believe under the pretext of 'Varna Vyavastha'.

Some people believe that the scavengers are reluctant to switch over to other jobs because scavenging, though a dirty job is a lighter one. From my experience as a field worker, I can say that this is merely maligning them. Their youth abhors to pick up a scraper and go round to clean the latrines. The older people are a bit neutral and continue this profession for lack of alternative employment. It has been my good fortune to visit some families who have resolved to plan to see that their children do not fall upon the degrading profession of scavenging.

Customary rights of scavenging are still prevalent in some provinces like Uttar Pradesh, Madhya Pradesh, Punjab,

Rajasthan, Gujarat, Maharashtra and Andhra. The Government of India, Department of Social Welfare, had constituted a committee under the chairmanship of Prof. N.R. Malkani to study the legal aspects of the problem and draw up a phased programme for the abolition of customary rights. The committee has submitted its report in 1966 recommending various measures to be taken to see that the scavengers leaving customary rights do not suffer in switching over to municipalization of scavenging.

Some people have created a wrong impression about the opposition of the scavengers to this switch-over. There are some scavengers who oppose it as they fear the bureaucratic attitude of the municipalities and the loss of income as each one of the affected is not assured employment in the municipalities.

The abolition of customary rights, as recommended by the Committee will not create Bhangi Mukti Society but it is no doubt a step in that direction. The children of such scavengers will not inherit latrines from their parents. That may divert them to other avenues of life. Care of course has to be taken to see that this reform does not add to their burdens.

Some of the social workers feel restive and desire the scavengers to raise their hands and declare that they no longer will continue to do this filthy job for which they are being treated as untouchables. As stated earlier there are about 5 lakhs of scavengers. They could take this adventurous bold step as some *chamars* in some provinces did, but they feel hesitant for fear of unemployment and starvation. The planning and strategy of work, is, therefore, desired to be 'Bhangi Kasht Mukti, for the present generation and 'Bhangi Mukti' for the next generation.

Education

- (a) Provision of creches for the children of the working mothers as is provided in Industrial concerns under the Factories Act 1948.

- (b) Provision of Balwadis (Pre-primary schools).
- (c) Enrolment in the primary schools.
- (d) Freeships and scholarships from primary to college education.
- (e) Enrolment in Industrial Training Institutes.
- (f) Ashram School as directed by Government of India, Ministry of Home Affairs vide letter No. F.23/64-SCT.II dated 10-4-1964.
- (g) Proper hostel facilities.

Types of Latrines

- (a) Prevention of further construction of dry latrines in new constructions as suggested by Government of India, Ministry Health and Family Planning vide letter No. F.6/21/66-LSG. dated 14-7-1967.
- (b) Conversion of previous dry latrines to hand-flush. The Social Programme Sub-Committee of Gandhi Centenary through Harijan Sevak Sangh has brought out posters and folders of various hand-flush latrines.
- (c) Fuller utilization of sewerage lines for converting dry to flush latrines.
- (d) Prevention of construction of dry public latrines by municipalities, Gram-Panchayats, Educational Institutions etc.

Alternative Employments

The scavengers will muster up courage if some other source of income is secured to them like Government Services in class IV. They could also be engaged in various cottage and village industries.

Contacts with the Balmikis

The most important and vital step to achieve 'Bhangi Mukti Society' is to create disgust and distaste in the scavengers and adopt ways and means to create consciousness in them that this is the job which has kept them untouchable

even amongst untouchables and that they have to say good-bye to their hereditary profession to enjoy social equality. They have to be made to understand that this type of monopoly has created lethargy in them and that this has marred their initiative. Following programme would be greatly helpful :—

- (a) Active contacts with their organisations.
- (b) Formation of *Yuvak Mandals* and Bhajan Parties.
- (c) Corner meetings and conferences
- (d) Publication of suitable literature.
- (e) Dramas and debates.
- (f) Publication of experiences of those who have taken to other professions.

Conclusions

The Society, Municipalities, Government and the workers have to rise to the occasion and create climate in this direction during Gandhi Centenary to pay real homage to the Father of the Nation and end the agony of the scavengers. The Balmiks are not only to be treated as equals but respected lest Gandhiji may not desire to be re-born as he had said “I do not want to be re-born. But if I have to be re-born, I should be born an untouchable, so that I may share their sorrow, sufferings and the affronts levelled at them, in order that I may endeavour to pull myself and them from that miserable condition. I, therefore, pray, that if I should be born again, I should do so not as a Brahmin. Kshatriya, Vaishya or Shudra but as an Anti-Shudra, a Bhangi”.

Delhi : 1967

—Jiwanlal Jairamdas

CHAPTER—I

THE PRESENT POSITION

There are 2245 towns in India of which 12 are corporations, 1294 municipalities and 931 notified areas. Only 35 of these towns are served by underground sewerage but even these do not cover the town's entire urban area. At least 8 to 10 Five-Year Plans, providing for an outlay of approximately 1,300 crores of rupees, will be necessary for laying underground sewerage in all the municipalities. The areas having more than 40 inches of rain-fall, would also require arrangements for rain-water drainage, along with sewerage.

Underground sewerage requires plentiful supply of water. The 245 towns in the country which, at present, have water supply, provide 20 gallons of water per head. 465 towns have partial water-supply. In the rest of the towns, not served by piped water-supply, people get only 5 to 10 gallons of water per head. One third of the towns have rocky soil. The First Five-Year Plan provided for a sum of Rs. 42.72 crores for water-supply and sanitation out of which only Rs. 4.3 crores were utilised. A sum of Rs. 63 crores was provided under this head in the Second Five-Year Plan, but only Rs. 45 crores were utilised. Rupees eighty nine crores were sanctioned for this purpose in the Third Five-Year Plan. These figures, show that the local-self government institutions did not take full advantage of these schemes.

The towns which have taken advantage of these schemes, however, have spent 95 per cent on water-supply and a meagre 5 per cent on sewerage. Sewers can be provided if at least one third of the money under this head is spent on it. One third to two thirds of the country's towns have, Kacha or Pakka, open-gutters only which are limbo of dirt and filth. They breed flies and mosquitoes. It will, indeed, be difficult to solve the

problem of latrines, until all the towns in the country are provided with underground sewerage.

The problem of latrines, in towns, big or small, which do not have underground sewerage and the machinery for sewage filtration, is rather difficult. Out of every ten, 3-4 houses in South India and 4-5 houses in North India have provision for latrines. About 50% of people ease themselves in the open. How far is it justified in an educated society, in this age of science ?

There is great need for public latrines, but unless the public has the necessary interest and education in health and sanitation, these will remain seats of filth and dirt. Public latrines can be useful only if adequate arrangements exist for their cleanliness. Arrangements should also be made for supply of water near the public latrines. The most important thing should be to ensure that every pucca house has a latrine. What type of latrine should be built must also receive consideration. Service latrines should not be built because the night-soil, water and urine from such latrines flow into the gutters. The night-soil continues to putrefy for two to three days in some places. If the latrines are not in good repair, pigs etc. enter into them and spread filth. Flies which sit on the night-soil also contaminate eatables in the kitchen. Who would prefer such dirty, foul-smelling and fly-ridden latrines at the entrance of his house ?

The person who cleans this latrine renders the most essential and important service to the society and is yet considered an untouchable. How far is it justified in a civilised society, for him to render this service under inhuman conditions ? Everybody wants a neat and clean latrine these days. The future generation of safai-kamdars will not continue this task. They would take to other industrial jobs. In the circumstances, scavenger-free latrine is the only remedy. Many types of latrines, such as the P.R.A.I., the Gopuri or the Wardha latrine, the trench latrine, the Septic Tank, the Aqua

Privy, the Bore-hole, the Pave sandas, the Dugwell latrine, the Hand Flush latrine, the Simple Septic latrine, the Gasplant latrine, the Chemical toilet, the Compost Privy, are being manufactured in the country.

The States of Gujarat, Kerala and Bihar have resolved that all new latrines should be of scavenger-free type like the Septic Tank, the Aqua Privy, the Hand-flush. This has been implemented in all the towns in these States. The State Governments or municipalities can encourage the conversion of the age-old service latrines into scavenger-free types by offering concessions, loans, grants etc. to the public. The municipalities of Patna, Jaipur, Bhavnagar, Mangrol have already initiated the scheme for grant of loans/concessions. Where private land for construction of soakage pits, cemented tanks for septic tanks, P.R.A.I. pits, is not available, the municipalities can make bye-laws permitting the construction of pits, tanks, etc. under the ground. A beginning in this direction has also been made in Kanpur, Varanasi, Patna, Dehra Doon etc. In smaller towns, even land is given for this purpose.

This book provides information regarding the construction and working of the various types of suitable sanitary latrines which are neat and clean, without foul smell and free from the menace of flies and mosquitoes.

The superstructure of these latrines can be made large or small according to one's financial resources. It would cost less to convert old service-latrine into neat and clean water-borne ones because the superstructures have already been built. They would only need a little modification. This book seeks to provide information regarding the types of latrines which would suit particular locations

CHAPTER—II

TYPES OF LATRINES AND HABIT OF CLEANLINESS

As soon as we hear the word “faeces” our hearts miss a beat. We feel like plugging our nose. Even the expression on our face changes. We recoil from any talk of latrines. Why is it so? It is because deep in our hearts we have the image of the latrine as a symbol of filth and stink and a veritable abode of flies. The reason for this lies in our own treatment of the latrine, which is at par with that of the scavenger. Strange enough, even the latrine that is constructed, is of the service type. Everybody has to ease oneself. How can the process of nature be stopped? Supposing we try not to answer the call of nature, the result will be our own illness. We do feel the necessity of latrines today, but have no good models for constructing them.

The Problem of Latrines

The civilized and educated people in the cities find it hard to ease themselves in the open. In the absence of latrines, one has per force to go out to ease in the open, but one does dislike it as a habit. He who feels the necessity of it would surely construct some kind of a latrine. In big cities like Bombay, there is little difficulty because of the existence of flush latrines. The faeces is easily conveyed through sewerage. But one has to face difficulties in towns, where conditions are otherwise. We find that mostly in smaller towns the problem of latrines has become very acute. Even the municipalities do not ponder over this question to see, as to how to construct latrines which may help improve the health of the town.

Necessity of Cleanliness and Improvement

Now-a-days, private and public ‘basket latrines’ are common in the towns. Men or women Bhangis (Scavengers)

clean them. These are, however, in such a rotten state that our minds revolt against their use. As soon as one steps in, he finds cobwebs on the interior walls. Indecent pictures and writings are seen all over the walls. One wonders why the precincts of the latrine itself excite base thoughts. One does not feel like using the public latrines as also those attached to the trains. The true importance of latrines has to be brought home to the people. Palatial buildings would be constructed and would also be kept in good repair but the latrines would always remain uncared for. Once the basket or the bucket breaks, we are not readily agreeable to pay for another, in spite of repeated requests of the scavenger. Still, we do not stop easing ourselves even in such latrines. The scavenger is obliged to clean even these latrines. Have we ever stopped to think that when the mere sight of the faeces is revolting to us, then what would be the feelings of the people who clean it? We talk glibly about removal of untouchability. But we force the same untouchables to carry our faeces. This disparity in status cannot last long. Cleaning of latrines should also be one of the normal tasks in the society. This should be on the same footing as agriculture, trade or any other household work. This should not be considered as the prerogative of a particular caste. The dirty latrines should be converted into modern ones. Humanity demands that the night-soil which one person considers as filth is not borne on head by another. Either we should give up the use of service latrines or else prepare ourselves for cleaning it.

Latrines Should be Like Temples

A latrine should be as clean as a temple. It is called 'Shaughghar' which means a place of purification. For the purification of our minds we visit temples, mosques or holy places. Similarly, for the purification of our bowels we visit latrines. Why should, then, the latrines be not like temples. When a clean and holy picture of the latrine will be before our eyes, we shall cease to detest it. We shall feel like cleaning it ourselves. The villagers in the country-side feel

irked on hearing any talk about latrines. How can those used to easing themselves in the open, like to ease in the dirty confines of the latrine? They can, therefore, surely build latrines which are neat and clean, without foul-smell, cheap, healthy and fly-free. We should remember that ours is an agricultural country. But our land is not fertile and we require manure. We should, therefore, construct latrines which are fully beneficial to us. By easing ourselves in the open, we only increase the filthiness of the villages. Flies breed and spread disease. With increase in diseases, our health deteriorates. Simultaneously, we lose valuable manure also. In villages it is a problem to find a place, away from the sight of women, to ease oneself. The necessity of latrines is, therefore, recognised by all.

Three Types of Latrines

We have three types of latrines in current use: (1) Those producing manure, (2) those not producing manure and (3) those needing extra service from scavengers. Anyway, we do get manure from the third type of latrines. But it would be better if this were to become a social work. The first type of latrine is more useful for the country. The Gopuri latrine and its various modifications, the farmer-latrine, Dr. Kessels' latrine, the Janta sandas, the simple septic, the Shauch Peti etc. yield more manure. One person's night-soil for a year yields manure worth Rs. 3 to Rs. 4. If we take the population of India as fifty crores, we can save Rs. 200 crores out of manure. The people of China and Japan understand the utility of night-soil as manure. Dr. Fowler has said that the soil in China and Japan has become fertile by the utilization of night-soil and urine. Faeces per head in India is 12 to 14 ounces.

Night-Soil Yield per Head per Day

In Asia	200-400 grammes	(7 to 14 oz.)
In Europe and America	100-150 grammes	(3.5 to 5.3 oz.)
In Tropics	280-530 grammes	(10 to 19 oz.)
In Phillipines	665 grammes	(1.5 Ratal)

Thus, why should we not make the Indian soil fertile by better utilisation of night-soil? Along with the manurial aspect, we should also give full consideration to the scientific and health points of view. The aforementioned manure-producing latrines could serve the purpose for hamlets and small villages with the population of upto fifteen thousand. For bigger towns, other types of latrines are more suitable. It is necessary to consider about the public and private latrines also among the manure producing ones.

The Second type of latrines are those which do not yield manure. They are better from the point of view of health and sanitation. But people are reluctant to build them in villages. Their cost of construction is also higher. They are costlier because many things have to be brought from outside. The Water-Seal, the Deep-pit, the Borehole, the Aqua Privy, the Septic Tank etc are the latrines which do not produce manure. One or two among them do yield manure in the form of earth after many years, and some others produce nitrogenous water. But how far would they be successful in the village conditions, depends on the villagers. Whatever the type of the latrine, it will not be popular unless people are made to understand its importance. Therefore, the first essential is to inculcate among the people the habit of using the latrine. It is difficult even to broach the question among people who do not use water after easing.

Family commode, commode latrine, bucket latrine, basket sandas etc. are the third type of latrines which need cleaning every day. Bucket latrine is simple and cheap. For those who are used to cleaning personally it is a neat latrine. But its use on a mass scale is difficult. The improved form of basket latrine is the Family Commode, whose cleaning operation is very easy. It has separate arrangements for water, urine and faeces etc. It is covered from above. Two buckets are provided in a small trolley underneath the commode which makes it easier to clean. It solves, to some extent, the problem of removal of scavengers' difficulties. We should not need the

tribe of scavengers now. If we want to abolish this institution, then this type of latrine is most useful for our homes. The entire structure being folding, it can be easily carried anywhere. It can even be placed on the second floor.

Many types of latrines are thus prevalent in our country. They are still being modified by the government and the constructive workers. The problem of public latrines is very difficult. Various types of latrines from among the aforementioned are in current use, but they still appear to need further improvement. In many places verandah latrines for women have been constructed by having an open space surrounded by walls. Very often animals get inside them and devour the faeces. Arrangements for their proper cleaning do not exist. With the result that women ease themselves at many places. It is a bad habit to go to such latrines without shoes. Such latrines should better be closed down.

Latrines With Gas Plants

Recently a new type of latrine has been devised which does not require the services of scavengers for cleaning. It produces manure as well as gas from the faeces and the urine. The gas can be used for fuel and light. By planning this type of gas-plant-cum-latrine in towns which are Tahsil Headquarters and are inhabited by 20-25 thousand persons, we can solve the problem of scavengers and also get rid of all sorts of difficulties. This project is still under trial and modification.

Be Latrine-Minded

To add to the richness, civic sense and cleanness of our country let us take to the use of latrines. Build latrines which are neat and clean without flies and foul smell, produce manure and are independent of service by scavengers. Make people latrine minded.

CHAPTER—III

THE SEPTIC TANK

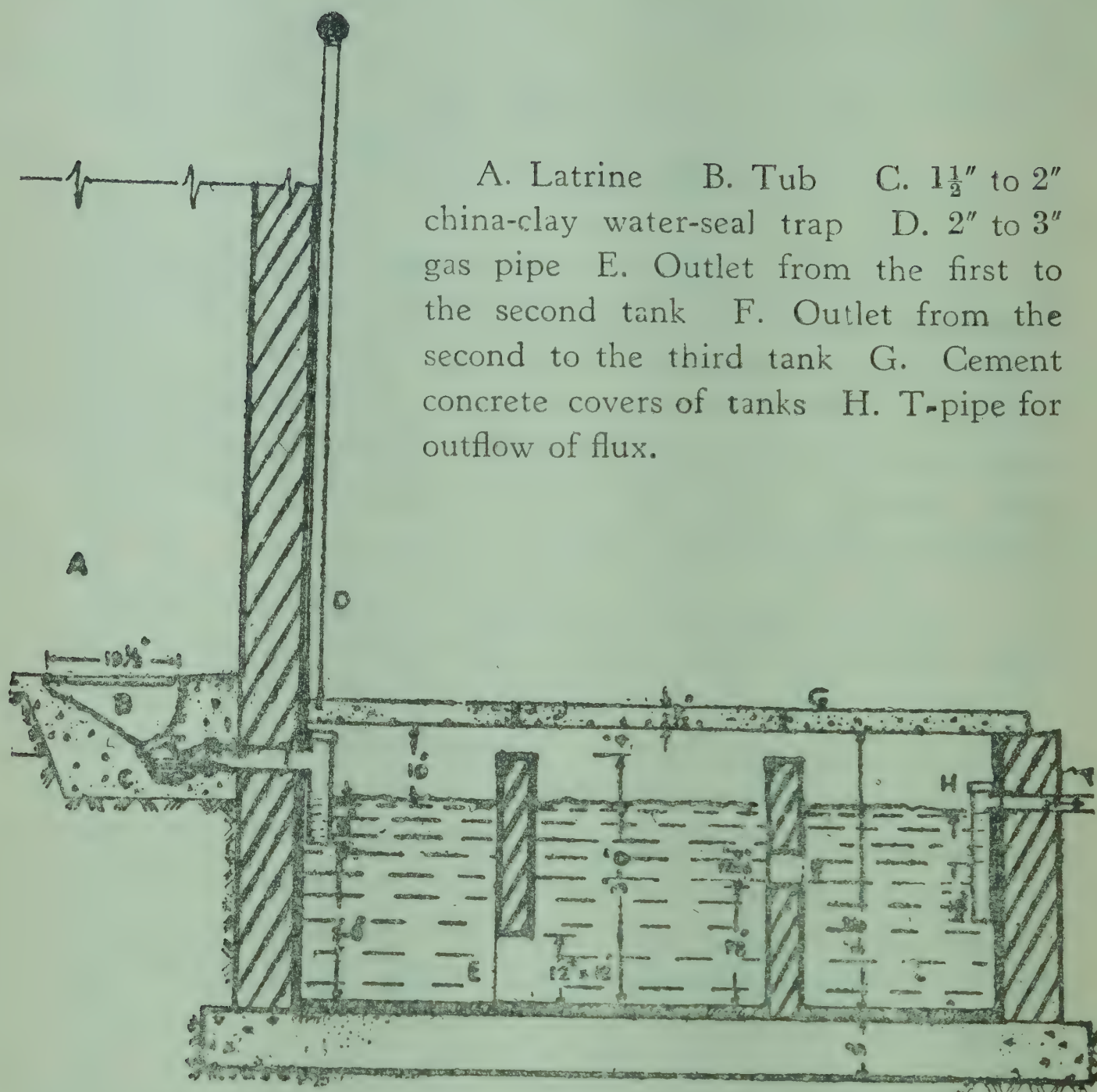
In towns which have no sewerage, the dirty water of small colonies, schools, bath rooms, kitchens and latrines etc. is purified by septic tanks. Such septic tanks are built in large sizes and, as such, require more water. 20-25 gallons of water per head per day is used in them. In these big septic tanks the sewage is kept for 12 hours when it is purified by chemical and enaerobic methods.

For the families, we will here consider only the septic tank latrines into which the service latrines can be usefully converted. The septic tanks constructed in the towns at present are bigger than those of standard size. These entail more expenditure and, therefore, normal families do not dare go in for them. One spends Rs. 1,000 to 1,500 in their construction so as to avoid the cleaning of the septic tanks for 18-20 years. Smaller septic tanks for families can be built on scientific lines with lesser outlay. These would cost Rs. 500/- each.

There is no latrine which does not require cleaning. Some have to be cleaned every five or six months while in some others the deposits, sludge and scum have to be removed after five to seven years. Even for the latrines which are connected with sewerage, sewage treatment plant has to be constructed on community basis. The smaller latrines, too, require cleanings.

What is Septic Tank ?

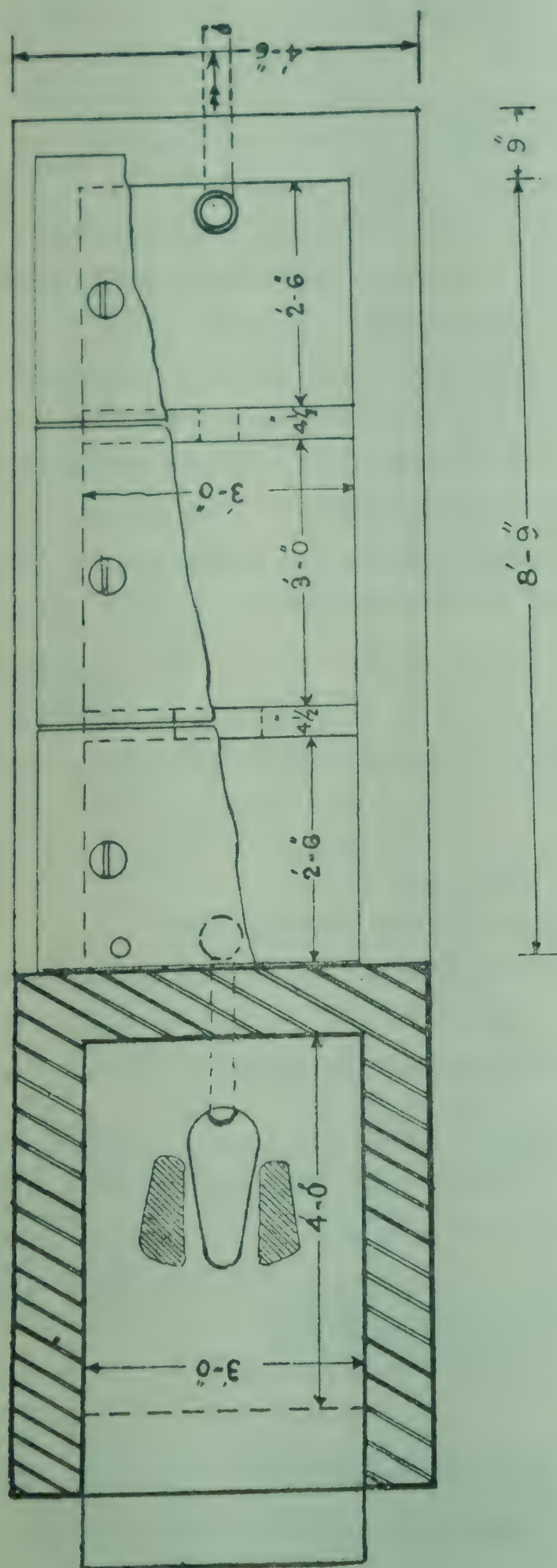
The night-soil along with urine and water which accumulates in the septic tank is liquified by chemical and enaerobic



Septic Tank

processes and goes out of the tank in the shape of water after 60 to 62% of purification. There are three pucca tanks which are kept dark and filled up with water. The latrine has a china-clay pan with trap and, therefore, remains neat and clean and free from flies and foul smell. The faeces is not visible to the eye. The water, used daily for ablution and 2 or 3 buckets of extra water, is sufficient for cleaning. The size of the tanks is constructed taking into account the condition of the soil, the climate and the number of persons. The Septic Tank gives satisfactory service for years.

Design of Septic Tank



Plan of a Septic Tank

In designing the Septic Tank, the time taken in the treatment of sewage based on the quantity of faeces, urine, water etc. flowing per day in the tank, is taken into consideration. It is also considered to provide space required to separate the sludge deposits and for the accumulation of the purified and digested sludge till it is taken out.

Generally, the time required for the treatment of an effluent of 10 gallons of water per day per head in a small septic tank is 24 hours. The time for the treatment of waste water from the bathroom, kitchen and the latrine at the rate of 20 to 25 gallons per head is calculated as 12 hours.

In this country, $1\frac{1}{2}$ cubic feet of space per head is considered sufficient for digestion of sludge. In tropics, the process of digestion and purification is faster.

Human faeces consists mostly of organic matter. Minerals—sand and earth—also go into the tank and, after digestion, settle down at the bottom. In India, 12 to 14 ounces of faeces and one to two pounds of urine is discharged by every person. In cold countries faeces is passed at the rate of 5 oz. per head and 0.0075 cft. of sludge is formed per head per day. The matter that settles down is called “sludge”. $1\frac{1}{2}$ cft. of sludge per head is formed in a year. In three to four years it becomes 4 cft. The sludge is formed in the tank and gases are formed by the putrefaction of organic matter. The tanks should be cleaned every three to four years. If it is cleaned after a longer duration the size of the tank shall have to be increased which will enhance the cost. If left uncleaned for longer duration, the sludge hardens at the bottom of the tank and so presents difficulties in removal. It is, therefore, better to clean the tanks after three or four years.

In this way, a “family septic tank” should be designed to provide space at the rate of 4 to 7 cft. per head. The following points should be kept in view while preparing the design :—

- (1) How much water is used per day ?
- (2) How much waste water flows into the tank ?
- (3) How much time is required for the treatment and digestion of waste water ?
- (4) What is the period fixed for cleaning the tank ?

It is necessary to provide an additional space of 35 to 40 per cent of the total capacity of the tank, for scum and sludge. An extra 25% open space (Free Board) should be provided in the upper portion of the tank. The capacity of a tank for the use of a family should not be less than 40 cft.

Construction

Three tanks should be built according to the size given in the diagram with 9" thick surrounding walls and $4\frac{1}{2}$ " thick baffles.

The bottom of the tank should have 6 to 8 inches of lime concrete and $1\frac{1}{2}$ inches of patent stone (floor finishing). The floor should slope towards the central tank.

Dimensions of Tank

The depth of the sewage should be 3' for smaller tanks and 6' for bigger tanks with 6" to 1' free board on top. The length should be $2\frac{1}{2}$ times that of the breadth.

Inlet and Outlet Pipes

A 4"-clay pipe or soil pipe or A.C. pipe is attached to the trap of the latrine according to its length. A 4-inch "T" or "elbow" is fixed to the tank. The "T" should remain immersed in tank water by 6" to 9".

A 4"- "T" outlet pipe should be so provided in the third tank that it remains immersed in the liquid from 6" to 9" and it should be fitted 3" to 6" below the level of the inlet pipe.

Baffles

At a distance of 2' to 2'-6" from the inlet pipe side of the tank, a baffle wall of $4\frac{1}{2}$ " thickness should be constructed and a hole $1' \times 1'$ made in the bottom at its centre.

2' to 2'-6' inside the tank from the outlet pipe side a $4\frac{1}{2}$ " thick baffle wall should be raised and a hole $6" \times 1'$ should be made in this wall 6" to 9" from the top. The baffle walls are built to check short circuiting of the effluent. In smaller tanks, a baffle wall built at $\frac{1}{3}$ rd of the length on the side of the inlet pipe will do. The baffles can be built by pieces of stone or by R.C.C. slabs.

Roof for Tanks

The tank can be covered by manhole covers of 3" to 4" thickness made of stone or R.C.C. slab. A small tank can be closed by placing three small slabs over it. The slabs should be joined by cement so that water does not flow into the tank or out of it. The outer slab should be watertight. The slab required to be lifted for cleaning should be fitted with an iron handle.

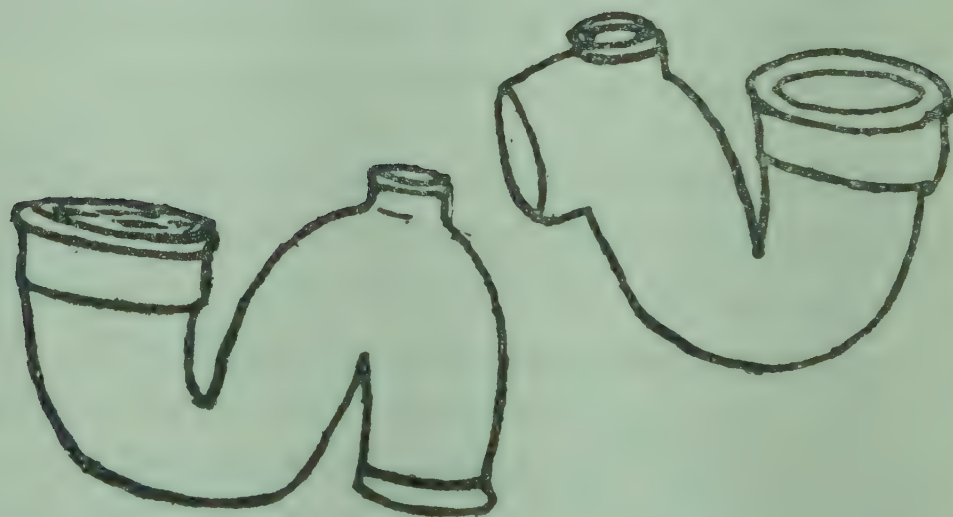
Gas Pipe

The tank is completely plastered from inside. Therefore, to provide an outlet for gases it should be fitted with at least 8 ft. high A.C. or soil pipe of $1\frac{1}{2}$ " to 2" diameter. It is better if the pipe reaches above the roof level.

Septic Tank Pan and Trap



China-clay pan of Septic Tank



"S" shaped 3" trap "P" shaped $1\frac{1}{2}$ " to $2\frac{1}{2}$ " trap

A "P" trap should be used for the septic tank. There is a water-seal of 1" to $1\frac{1}{2}$ " in the trap which prevents bad smell, flies, mosquitoes, insects etc. Less water will be consumed by a water-seal of $\frac{3}{4}$ ". The pan should be 18" to 20" long with a slope of 8" so that faeces may easily pass through that trap even with a small quantity of water. For this purpose, China clay pan and trap may be used.

Chemical Reaction in the Septic Tank

The word "septic" has been derived from "septos" (rot). When anything decomposes it softens and changes into liquid. The liquid turns into gas and passes into the air. All organic matter—animal or plant—on decomposition, turns into liquid and then into gases. Even when the entire matter does not turn into gas, it decreases in weight and size. The whole process is effected by internal chemical reaction. The chemical reaction continues till the organic matter decomposes into its component elements.

Conditions conducive to decomposition of the faeces are created in the Septic Tank. As a result, the faeces changes from solid to the gaseous state. The remaining part is digested and left as a harmless residue. The minute organism of the faeces, called anaerobic bacteria, die in the oxygen of the air. Even the light is intolerable to these bacteria. There should, therefore, be no light or air for the anaerobic bacteria. This condition is automatically obtained by the location of the tank under the ground.

In the septic tank, the faeces is changed from the solid to the gaseous state by the anaerobic bacteria. The water which later flows out retains some impurities which are removed by another type of aerobic bacteria. The anaerobic bacteria bring about 70 to 82% of purification in the tank. The rest of the work is done by aerobic bacteria through oxygen in the air. The digestive action takes place in the elementary components of faeces—the nitrogen, carbon and hydrogen. When oxygen unites with these elements stable odourless compounds are formed. Nitrogen first changes into nitrous acid and then into nitric acid. Carbon gives out carbonic acid gas and hydrogen produces water.

Faeces comprises 35% of organic matter and 65% of minerals. Salts etc. taken with the food are the mineral components of faeces.

Neither of the bacteria has any effect on the minerals. Lighter particles in them float on the water and flow out with it. The heavier parts settle at the bottom and are removed at the time of cleaning of the tank. Some parts of the organic matter are lighter and others heavier. The lighter parts float on the water and the heavier ones settle down in the tank.

Both these are purified by chemical action. They are very useful for the growth of bacteria. The substances at the bottom, after putrefaction by the bacteria, rise up in the form of gases. The solid particles also rise up with them. Sometimes, when the construction of the tank is faulty, particles of solid matter flow out with the water and emit foul smell. The effluent is purified by aerobic bacteria. The organic matter consists of protein, carbohydrate, urea, fat etc. In human organism some parts of the food are digested soon and others take longer. Similar is the case with the faeces in the septic tank. The urea in the faeces is soon converted into ammonia. It does not stay in the tank but mixes with the oxygen in the air outside the tank and forms nitrous acid and then converts into nitric acid. Thus, all the organic matter passes through the putrefication, liquification and denitrification stages. The residue combines with the oxygen of the air to form nitrites and nitrates and thus transform into a stable and harmless substance.

There is vast difference between the sewage flowing into the tank and the effluent coming out of it. (1) The sewage contains sand, earth and other minerals whereas the effluent is free from them. (2) The influx (in-flowing liquid) has innumerable floating particles of solid faeces while the effluent has much less of them. (3) The former is yellow whereas the latter is black. (4) The inflowing sewage contains alluminides, urea etc. while the outflowing water has, instead, ammonia, Methane, Carbonic acid gas, sulphurated hydrogen (H_2S) etc.

Purification is done in two parts. One takes place inside the tank and the other outside it. The process inside the

tank consists of sedimentation of heavier particles and chemical decomposition of the other organic matter which includes both putrefication as well as liquification. Oxidation of the unstable gases in the effluent water takes place on their contact with the oxygen in the air. In both these processes the number of bacteria in the waste water increases. Purification takes place in both but by adverse processes.

The bacteria cause decomposition due to anaerobic action and bring about denitrification. As a result, the substances putrefy, liquify and give odour. In aerobic process unification of the elementary constituents of matter occur, e.g. carbon dioxide (CO_2) is formed from carbon, water (H_2O) from hydrogen and nitrates from nitrogen and this decreases the odour.

If a septic tank is to be run by an individual, the following should be kept in view :—

- (1) Light and air should have no ingress in the tank.
- (2) The tank should be kept filled with water. It is better if the waste water is retained there for more than 24 hours.
- (3) Water should be so released as not to disturb the sludge below or the scum above. The anaerobic bacteria live in larger numbers above the scum and below the sludge. Their action is retarded by disturbances in the water.
- (4) Phenyle, D.D.T., Soap-water etc. should not be allowed to flow into the tank.
- (5) The tanks should be cleared every three to four years.

Effluent Water

The water flowing out after purification may be allowed to flow into any water course nearby provided there is abundant water in it but it is not used for drinking purposes.

This water can be used for manuring plantains, papayas and other plants. Forty sq. feet of land is required per head for gardening.

Where there is no space and the water cannot be used for any purpose it should be allowed to flow in soakage pits. If there is a large volume of water then it should be dispersed on the ground through soakage drains. Clear water can be obtained if it is allowed to filter through gravel spread over an iron or cement netting $\frac{1}{2}$ " to 1" thick and affixed at a height of 1' from the bottom of the third chamber of the septic tank. But where the water has to be let off in soakage pits, soakage drains or cesspools, the filter bed is not necessary.

Hume septic tanks of cement-concrete are also available. Three tanks can also be used by joining them with 4" A.C. pipes.

Public Septic Tank

Septic tanks with trap and tub cannot be easily utilised as a public utility. The trap gets choked up with pieces of stone, bricks etc. with the result that water cannot flush it out and it also requires plenty of water. In the absence of enough water the tubs sometimes remain filled up with faeces. A running-water-gutter can be usefully constructed beneath the seats of the latrines. Some municipalities have used such gutters with automatic flushing arrangements, but they were not felt to be very successful.

For a unit of five latrines tiled flooring 16" long, 7" broad with a slope of 45° should be provided in place of each tub. On the elevated side, foot-rests should be constructed leaving a space of 6" behind them. Behind the latrines a gutter 6" broad and 15" deep with a slope of an inch to a foot should be built as shown in the diagram. It should have a pipe of china-clay. Faeces from the latrines will fall in this gutter. It should be covered with pieces of stone slabs so as to allow it to be opened from above. A tank of 25 to 50 gallon capacity should be constructed near the first latrine keeping in view the height of the gutter, and it should be provided with a $1\frac{1}{2}$ " to 2" wheel-valve facing the gutter. If there is a provision of water supply the tank can be filled directly by the

water tap opening into it. The tank should be covered by a cement-concrete slab. If there is no provision of direct supply of water, the tank should be filled daily by water borne by a bullock cart or a tanker. Arrangement should be made for cleaning the latrines twice or thrice every day. Water should be let off in the gutter by opening the wheel valve of the tank. Faeces accumulated in the gutter will be carried by the water to the septic tanks. The further end of the gutter near the septic tank should be joined by a syphon pipe of 6", which would obviate the necessity of water-sealing of all the latrines. The syphon pipe near the septic tank will provide the water seal. Two such units can also be joined together.

CHAPTER—IV

AQUA PRIVY

Aqua Privy is the improved form of the Septic Tank. This type is more useful in a town where there is no water supply, or water is in short supply. Aqua Privy works successfully from the point of view of a public latrine. Septic Tank requires plenty of water for flushing while this latrine does not require water for flushing. As the effluent water from a Septic Tank is plentiful, it is easier to arrange for its outlet.

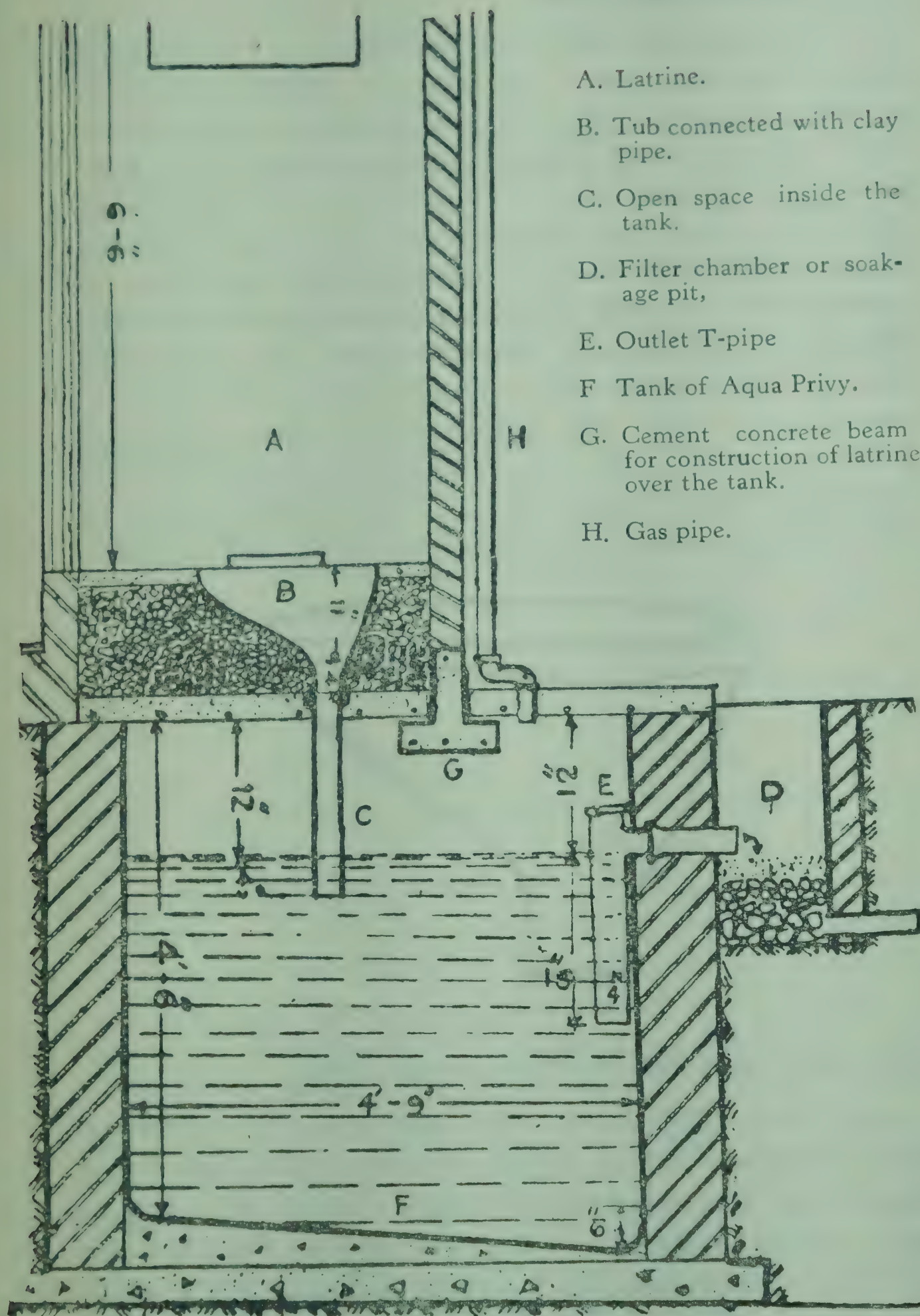
Construction of Aqua Privy

Three Cu. ft. of space per head is required for constructing an Aqua Privy for a family. The capacity of the tank should not be less than 40 Cu. ft. For an Aqua Privy for public use, 4 Cu. ft. of space should be provided per head.

The Aqua Privy can be made circular, rectangular or square in shape according to the availability of space. For a family, the inner depth of the tank can be 3' to 5' as shown in the diagram. The sludge or the earth, pieces of stone, minerals etc., which accumulate in the tank in five years cover 40 to 50% of the space meant for water. They should be cleaned so as to permit the tank to be used again.

A round pipe of cement concrete can also be used for an Aqua Privy. The bottom should be made pucca by cement concrete so as not to let even the smallest quantity of inside water leak out. The seat portion above should be airtight.

If there is space underneath a service latrine and enough elbowroom for cleaning it, then it can be converted into an Aqua Privy at a small cost.



Aqua privy for a family

Construction of the Tank

A pucca tank $4\frac{1}{2}' \times 3' \times 3' - 8''$ should be constructed below the ground level. The tank-wall should be built 9" thick with cement mortar. It should rise 15" above the ground level. A 3" thick R.C.C. slab divided in two parts should be placed on the tank. A 3"—4" china-clay pipe should be so fixed in one of the slabs under the pan as to remain immersed 4" to 6" in the tank's water. The other slab should be so cemented that it could be opened for cleaning the tank. The pan pipe should be 4" to 6" inside the tank. An outlet "T" pipe of 4" diameter should be so fixed as to remain 1' to 1'—6" immersed in water. By this arrangement the sludge will accumulate in one part. There should be a slope of 4" to 6" towards the outlet pipe in the tank. Its bottom should be pucca and the walls plastered so as to avoid leakage of water.



Aqua Privy Pan

Construction of Pan and Seat on the Tank

A Septic Tank is fitted with a water-seal trap and the seat is not directly above its tank. The seat of the Aqua Privy, however, is right on the tank itself and, instead of a trap, a pipe remains immersed in the tank water. Its pan is also different in shape from that of the Septic Tank. As a result, the slope is greater. The foot-rests are so constructed that the faeces fall directly inside the pipe. The pipe is attached through a 4" hole in the slab on the tank and a pan is fitted

over it. If per chance, the pan gets broken, it is easily replaced by another and the necessity of lifting the slab completely is obviated.

It will be better if water seal pan of the Hand Flush latrine is fitted in the family Aqua Privy.

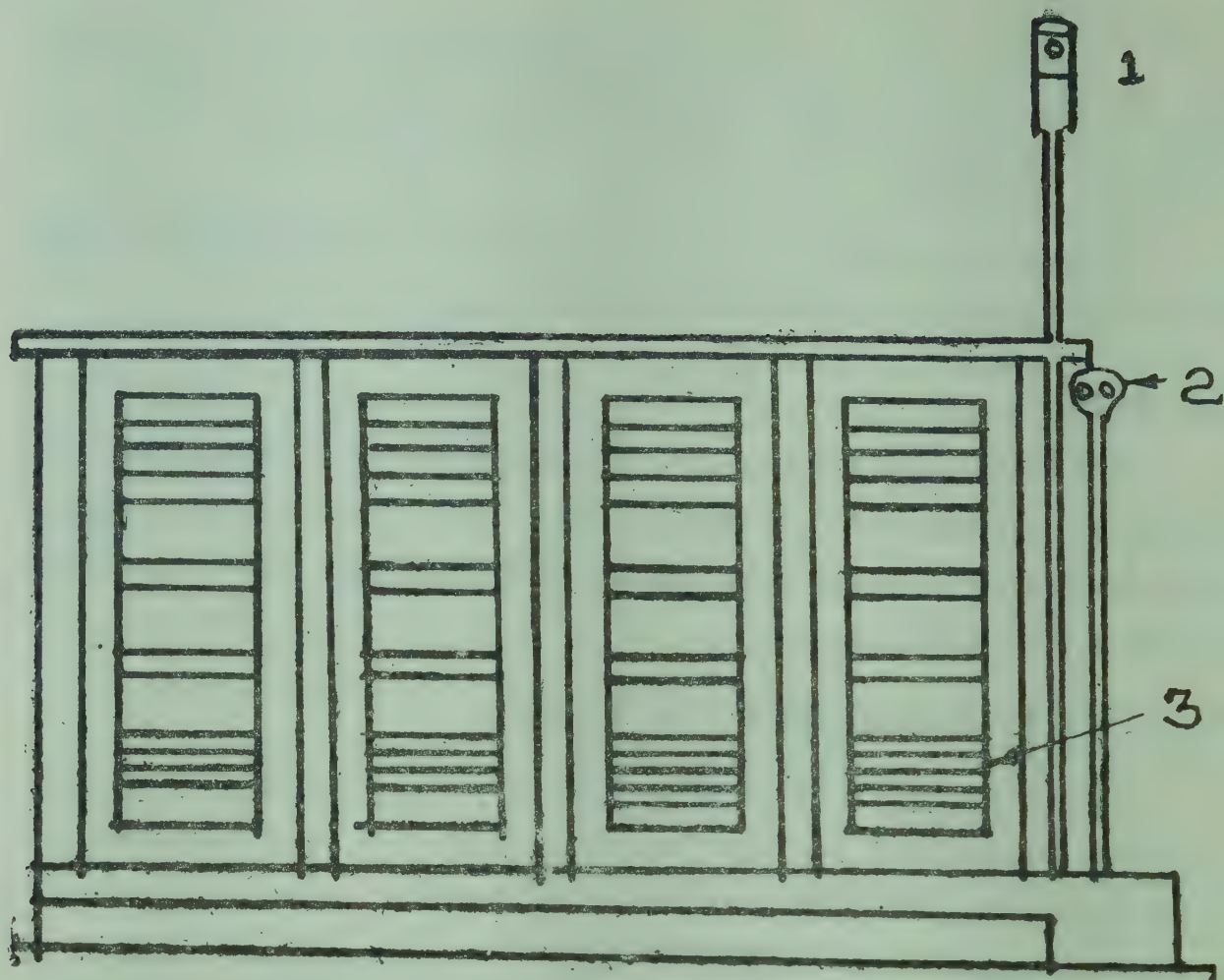
Gas Pipe

A $1\frac{1}{2}$ " to 2" thick cement pipe should be fitted for the egress of gases formed inside the tank in the process of putrefaction. It should be atleast 10 feet high and preferably rise above the ceiling.

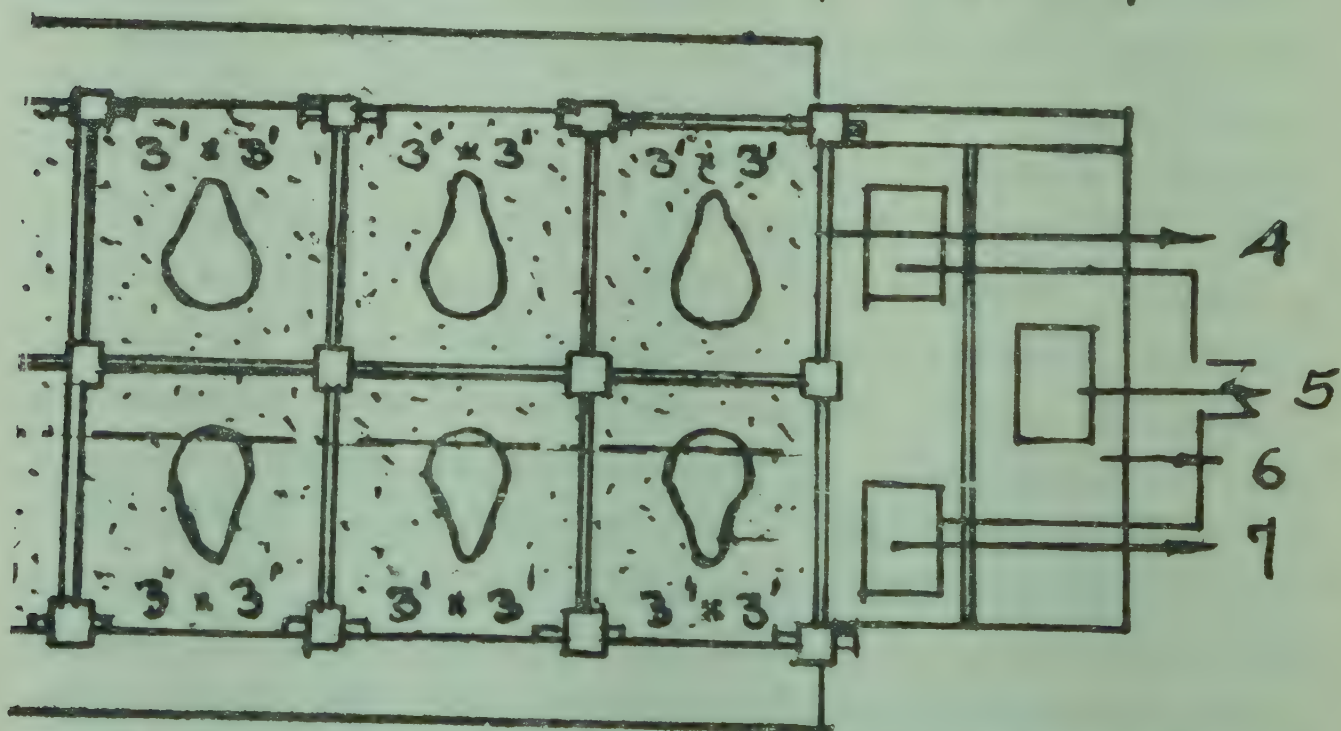
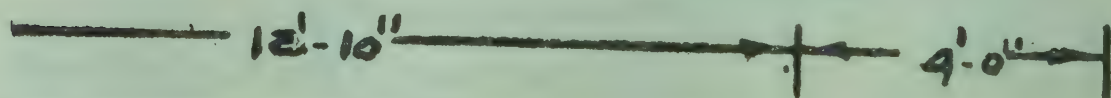
Reaction in the Aqua Privy Tank

The pipe fitted with the pan in the Aqua Privy tank remains immersed in the water. The pan has considerable slope and the foot-rests are fitted at a place from where the faeces can go directly into the pipe. As the faeces drops inside the pipe it passes on to the tank and floats in the water there. Here chemical action by anaerobic process starts as in the Septic Tank. As a result, the faeces turn into effluent and gases. Minerals settle at the bottom in the shape of sludge while oily, fatty and buoyant substances remain on the surface. These are turned into gases and effluent by the action of bacteria. A single-tank Aqua Privy is sufficient for a family. There is no necessity for another tank for aerobic reaction. Another tank has to be constructed for aerobic reaction in public latrines. Holes of 6" to 9" diameter are made at a height of 1'—6" from the bottom according to need for the flow of the effluent into the other tank. For the inlet of air for this aerobic process, a 6 ft. long pipe of 3" diameter is fixed in the upper portion with a wire netting at its mouth to keep out mosquitoes while allowing the air to pass through. By the oxidation in the second tank, unstable organic matter turns into stable organic matter and becomes odourless.

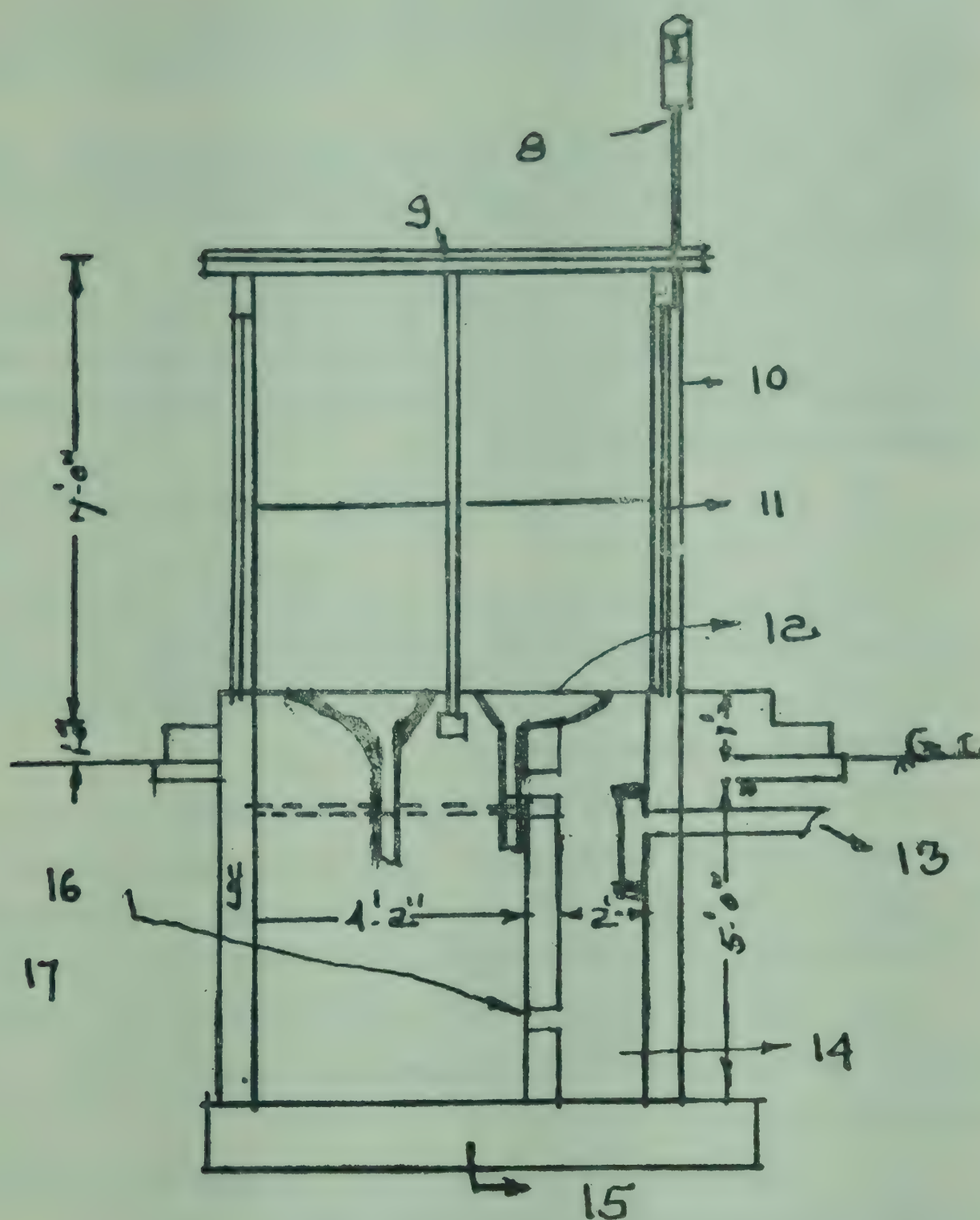
It is not necessary to pour extra water every day in the tank. Water taken by a person for ablution is sufficient for



Public Aqua Privy



1. Outlet pipe for gas. 2. Inlet pipe for passage of air in the tank. 3. Latrine 4. Beam for construction of latrine. 5, 6 & 7 covers for tank. 8. Mica flap on the gas pipes. 9. RCC cover over latrines. 10 & 11. Windows. 12. Aqua pan attached to the tank pipe. 13. T-pipe for exit of effluent from the second tank. 14. Second tank for latrines. 15. Pucca bottom of tanks. 16. Passage for the effluent from the first to the second tank.



chemical reaction in the faeces. Two to three buckets of water may be used for cleaning.

Useful Facts and Information

(1) Before the functioning of the Aqua Privy, water is filled so that it may flow out of the outlet pipe.

(2) In order to expedite chemical reaction in the faeces, it will be better to add a bucket or two of water in the Septic Tank or Aqua Privy.

(3) The tank should be well plastered so that there may be no leakage from it. The level of water in the tank should not fall.

(4) The pipe attached to the pan should remain immersed in tank. If the water level is low, more should be added to keep the pipe immersed.

(5) The tank covers should not remain open, because in that case the reaction will not set in and raw faeces will flow out. Therefore, after cleaning the tank, the slab (cover) should be refixed with cement.

(6) The pipes for the outlet of gas and ingress of air should be in proper order.

(7) If per chance the faeces block the pipe attached to the tank, then it should be pushed back into the tank with a rod fitted with a disc of the same dimension as the pipe and a few buckets of water poured in.

(8) Phenyl, D.D.T. etc. should not be used.

(9) Minerals, earth, ashes, stones etc. accumulated in the tank should be removed after five or six years. The tanks of public latrine should be cleaned once a year or as necessary.

(10) In public latrines, 20-25 gallons of water should be poured once a week. Water pipes should not be fitted in the latrines.

(11) A small tank filled with water should be provided near the public latrine for cleaning purposes.

Tank's Effluent

The effluent from public latrines, after filtration through the purification tank, should be used for watering plants and trees or let off in soakage pits, cesspools etc. It can be pumped into a tanker and taken to a manure centre by the Municipality. As the effluent from the Aqua Privy also contains pathogenic bacteria, it should be used with care. Manure can be prepared in $1\frac{1}{2}$ ' deep trenches. Pathogenic bacteria cannot last long in the sun outside the tank. If there

is a compost pit nearby, the waste water can be supplied to it in a regulated manner.

With some modification in design, this latrine is being put to use in Maharashtra as Naigaon Sandas, in which water is taken out every two or three days by buckets after removing the cover of the outlet pipe.

The water seal pan of the Hand-Flush latrine can also be used in the family Aqua Privy. It should, however, be ensured that there is water in the water-seal pan because otherwise the latrine will give foul smell.

Benefits of Aqua Privy

(1) Aqua Privy can be built on any kind of soil, whether it is gravellous, black or sandy.

(2) The Aqua Privy latrine is more successful as a public latrine than any other scavenger-free latrine because the seat being right over the tank the pipe is directly immersed in it. Rags, pieces of wood and stone etc. thrown by urchins settle in the tank. These things block the trap of the Septic Tank and cause lot of difficulty for cleaning.

(3) Water is not needed for flushing; the water used for ablution with additional two or three buckets used for cleaning is quite enough.

(4) The reaction in the Aqua Privy being spontaneous, a slight care is all that is required.

(5) It is free from flies, mosquitoes and filth and does not require scavenging.

(6) Not accounting roof, it costs only Rs. 250-300 for a family. The total construction costs Rs. 400-600.

(7) It is easier to construct a public latrine with eight seats. This can be made into two units. The dimensions of this tank are given in the diagram.

(8) The seat being above the tank, it requires less space and expenditure.

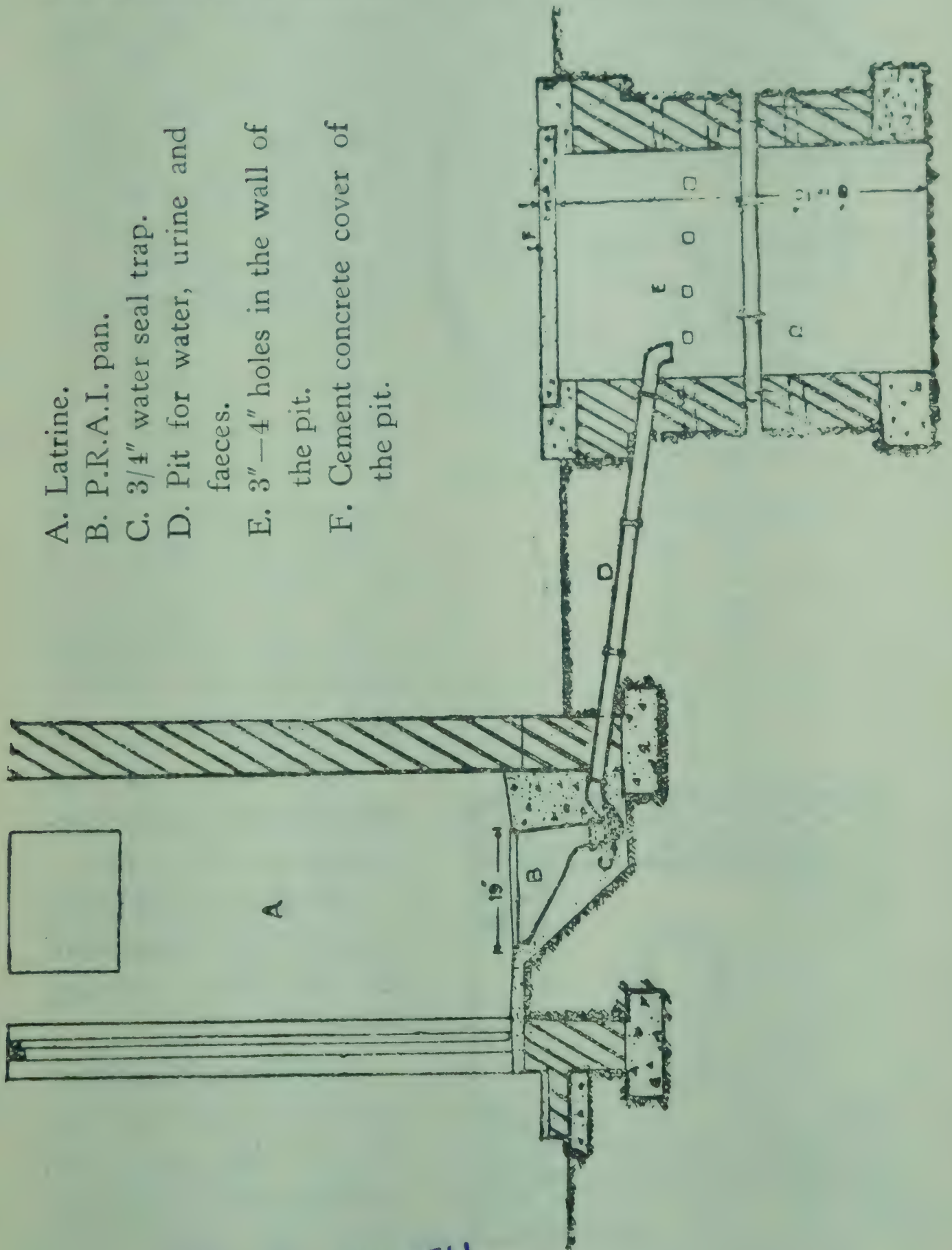
One drawback of this latrine, however, is that if even a small amount of faeces or effluent remains inside the pan-pipe, the flies will lay eggs. But this can be obviated by a little care. Training is necessary for its correct use.

CHAPTER—V

P.R.A.I. LATRINE

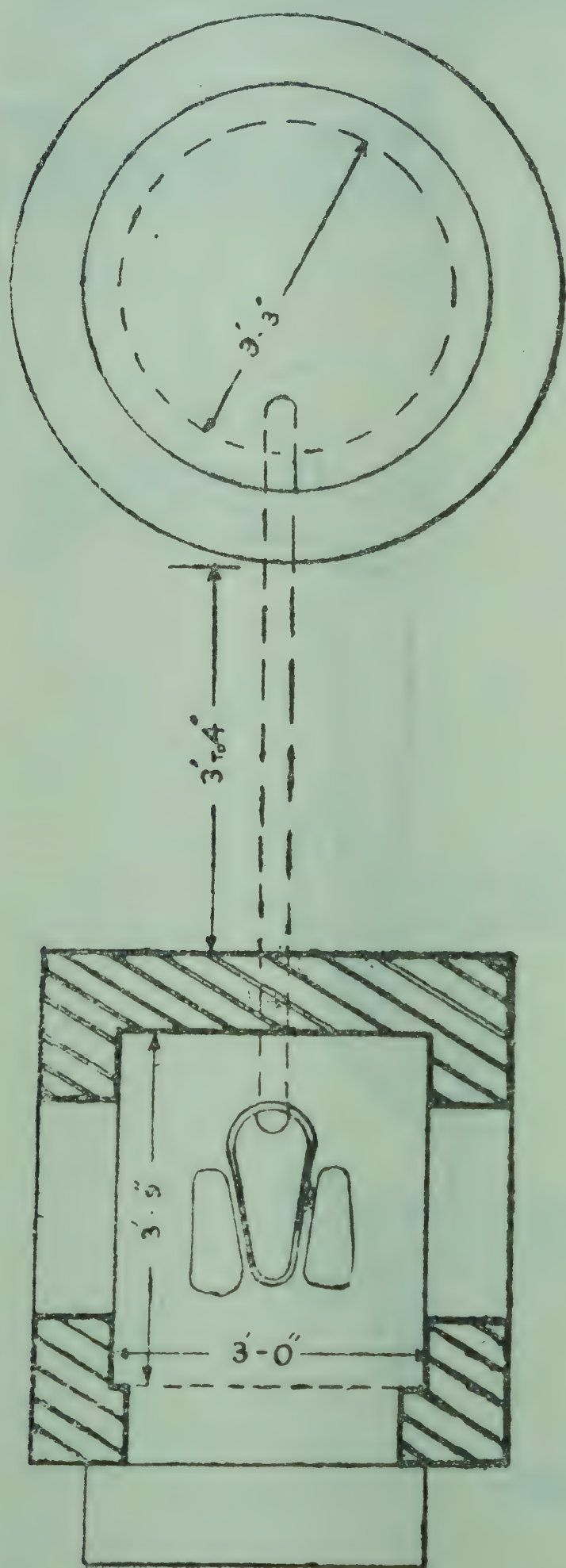
Who would like a basket type of latrine in these days ?
Who is not sick of this filth ? Who would like that flies sodden

- A. Latrine.
- B. P.R.A.I. pan.
- C. $3\frac{1}{4}$ " water seal trap.
- D. Pit for water, urine and faeces.
- E. 3"—4" holes in the wall of the pit.
- F. Cement concrete cover of the pit.



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Koramangala
Bangalore-560034

with excreta should contaminate food stuffs with germs of typhoid, cholera and other diseases by sitting over them? No one would like to have in his courtyard a latrine which is full



of stench, insects and flies. The person cleaning such a latrine is also a human being. Who would like to be treated in this inhuman manner in this age of science? It is for this that the cheap, simple, clean and stench-free P. R. A. I. latrine was evolved. This was improved upon by the Planning Research Action Institute, Lucknow, at the instance of the Health Department and was consequently named P.R A.I. latrine.

Selection of Site

(1) Basket type latrines can be easily converted into this type.

(2) It can be constructed at a distance of 25 ft. from drinking wells.

(3) There is no harm in constructing this latrine, if the water level in the wells is 25-30 feet below the surface. The direction of the ingress of water into the wells

should be ascertained and the latrine should be constructed in the opposite direction to avoid any chance of contamination of the well water.

(4) A site where rain water collects should not be selected.

(5) In case private land for construction of pits be not available the Municipality can enact bye-laws permitting necessary sanction for this purpose. Many Municipalities have already taken steps in this direction.

List of articles and estimate of their approximate cost for converting a basket type latrine into P.R.A.I. latrine :

<i>Articles</i>	<i>Estimate of expenditure on Kacha pit latrine</i>	<i>Estimate of expenditure on Pucca pit latrine</i>
Cement pan	Rs. 5 00	—
China-clay pan & trap	—	Rs. 25.00
4' long 4"-clay pipe or A.C. pipe	8.00	8.00
150 bricks for construction work	9.00	—
750 bricks for Pakka work	—	45.00
One bag cement for Kacha latrine	12.00	—
1½ bags for Pucca latrine	—	18.00
Sand	6.00	6.00
Iron bars 2-suti for covers	6.00	6.00
Digging of kacha pits	12.00	—
„ pucca pits	—	15.00
Construction and finishing etc. of latrine and pit.	15.00	30.00
	<hr/> 73.00	<hr/> 153.00

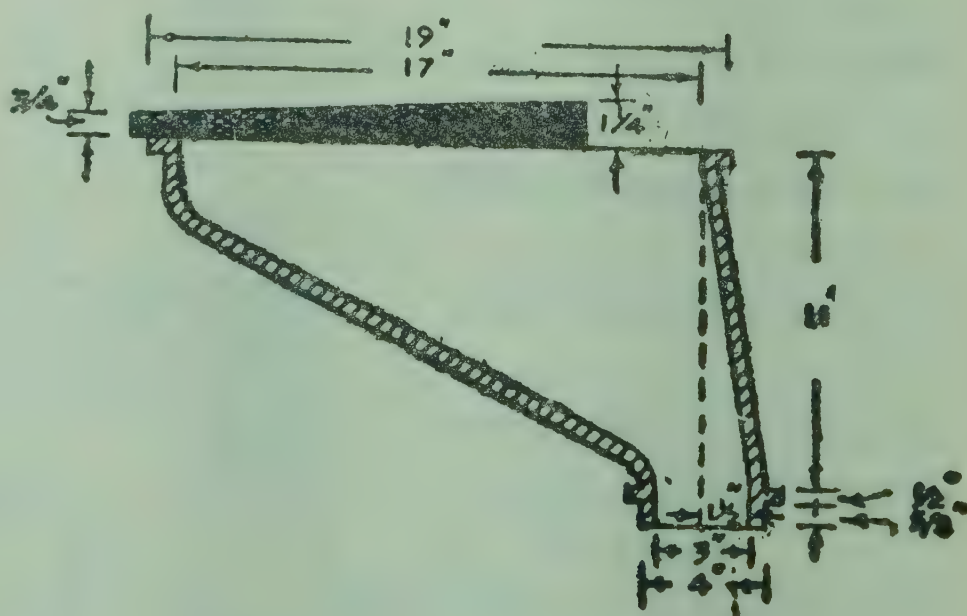
The above estimate has been prepared keeping in view the maximum prices obtaining in big towns,

In case a kacha pit is desired, then it should resemble a pale from inside so that earth may not fall from the top. If

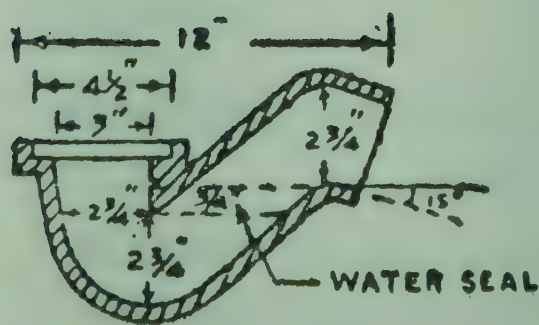
the digging and plumbing of pits is done by oneself and second-hand material is used, then the cost of construction of the latrine would be much less. The construction of the roof and walls may be done with material available locally and expenditure incurred according to one's means. There is no harm in using stone for construction work.

Latrine Pan

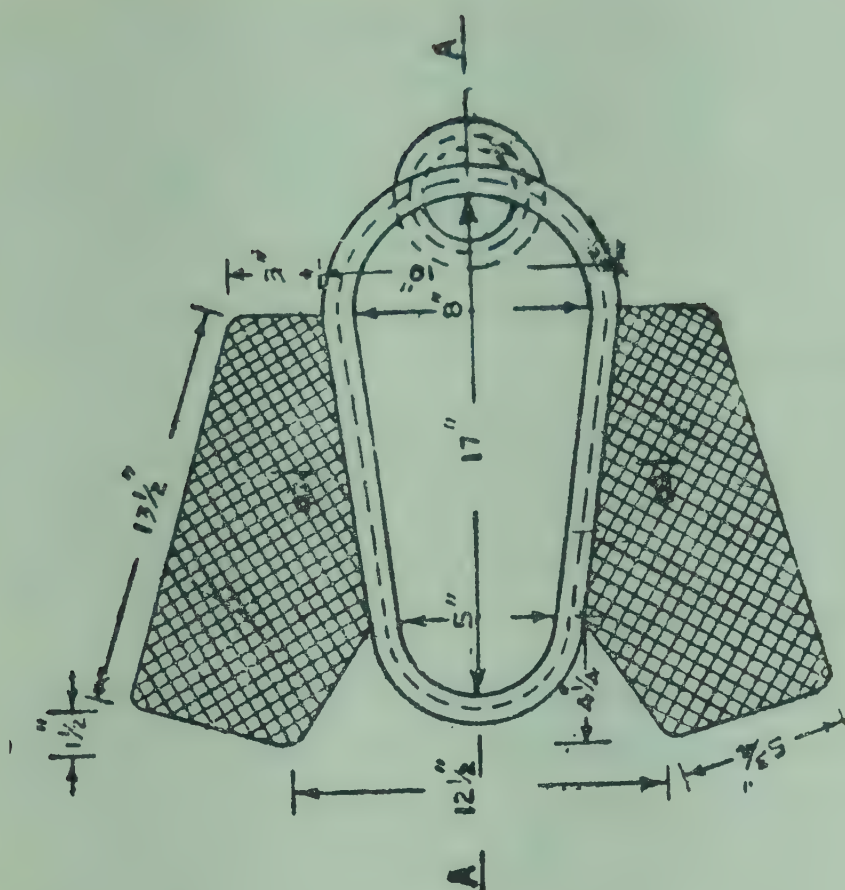
A pan of small size but with big slope should be selected so that the faeces may slide down to the trap without the use of extra water. The pan should be 17" long and 5" broad and 3" deep in the front and not more than 8" wide at the rear with a slope of 25° and a hole of 3" diameter for the passage of the faeces. A mould can be obtained from the Lucknow Research Centre for preparing this type of pan. 5 lbs. of cement is sufficient for it. The pan of the Hand-Flush latrine can also be used in this latrine.



A-A



1. 19" cement pan
2. Pan with foot-rest
3. $\frac{3}{4}$ " water-seal trap



Water Seal Trap

To avoid stench and to prevent flies from getting into the hole, a "P"-pipe trap is attached to the pan. This trap contains water upto $3/4$ ". With a $3/4$ " trap, faeces is flushed out with only 3 to 5 pounds of water. The bigger the seal in the trap, the more water will be required for flushing out. The trap can also be prepared with cement by means of a mould. No trap is, however, required if the pan of a Hand-Flush latrine is used.

Pipe for Passage of Faeces in the Pit

A cement pipe (A.C pipe), soil pipe or china-clay pipe of 3" to 4" diameter is so attached to the pan that it protrudes 6" inside the pit. The pipe should be 1' below the ground level. The number of pipe-bends and other sanitary fittings required for converting an old latrine depends on circumstances.

Pit for Faeces

There should be open space behind and on either side of the latrine. If there is no thoroughfare, then a kacha pit

can be dug. It should be a circular pit of 10' × 3' dimensions. Circular pits are stronger and more lasting than the square or the rectangular ones. It should resemble the shape of a Balti so that earth may not cave in from above. About a foot or a foot and a half of the upper portion of the pit should be cemented with brick or stone so that rain water and earth may not get inside it.

For a pucca pit, a circular pit 10' × 4' may be dug. The last two layers may be made in brick of 9" width with 1:6 cement mortar. The inner diameter should be 3'-3". The walls should be 4½" thick.

In every brick layer, four or five holes of 4" each should be made to allow the waste water to flow out into the soil. In the upper portion, four or six layers should be laid 9" wide but should have no holes. The last layer should be 6" below the ground level, so that with the cover on, it may be level with the earth. Mud mortar can also be used, provided heavy vehicles do not pass that way.

The pit should not be deeper than 10 ft. as otherwise it will have to be made with 6" thick brick walls which will enhance the cost. The pit should not be so deep as to touch the ground-water level otherwise the water in the wells nearby would get contaminated.

Cover of the Pit

A cover of 4' diameter and 3" to 4" thickness should be prepared from a cement mixture of 1:2:4. Iron rods of two "suts" thickness should be used for it. Four handles should also be fixed for raising the cover. It should remain covered with water for ten days to make it strong. After the cover is ready, it should be fixed over the pit with cement so that stench may not come out of it or water from outside may not get into it.

Gas Pipe

There is no need to fix a gaspipe in this latrine. Gas pipe can be fitted to latrines having pucca pits plastered with

cement like the Septic Tank and Aqua Privy. If the latrine is connected with sewerage, then also a gas pipe is fitted on account of the pressure of the gas from the sewer. This being a cesspool type of pit, the gas is absorbed by the soil and there is little pressure of the gas.

Useful Information

Generally, a family in India should be considered to consist of 7 to 10 persons for which a pit of the above size suffices for 6 to 10 years. One person passes 12 to 14 oz. of faeces. The reaction which takes place in the Septic Tank by enaerobic bacteria also occurs in this latrine. The effluent of faeces changes into gases etc. and is absorbed by the soil in greater or lesser quantity depending on the type of soil. The sludge, earth, sand and other minerals found in the faeces accumulate in the pit. The sludge per head per year is $\frac{3}{4}$ to 1 cubic foot which is removed and the pit is used again.

After removing the cover and keeping the pit open for a day, the black sludge is removed by buckets. It will not give much stench. While removing it, lime, bleaching powder or gamaxine be sprinkled over it. Thus, a good quality manure worth Rs. 15 to 20 is obtained.

The pathogenic bacteria which cause disease, die in a few days in the pit for lack of suitable air. They cannot go more than 10 ft. deep or 3 ft. on the sides along with the water absorbed by the pit and as such there is no danger of the contamination of well water.

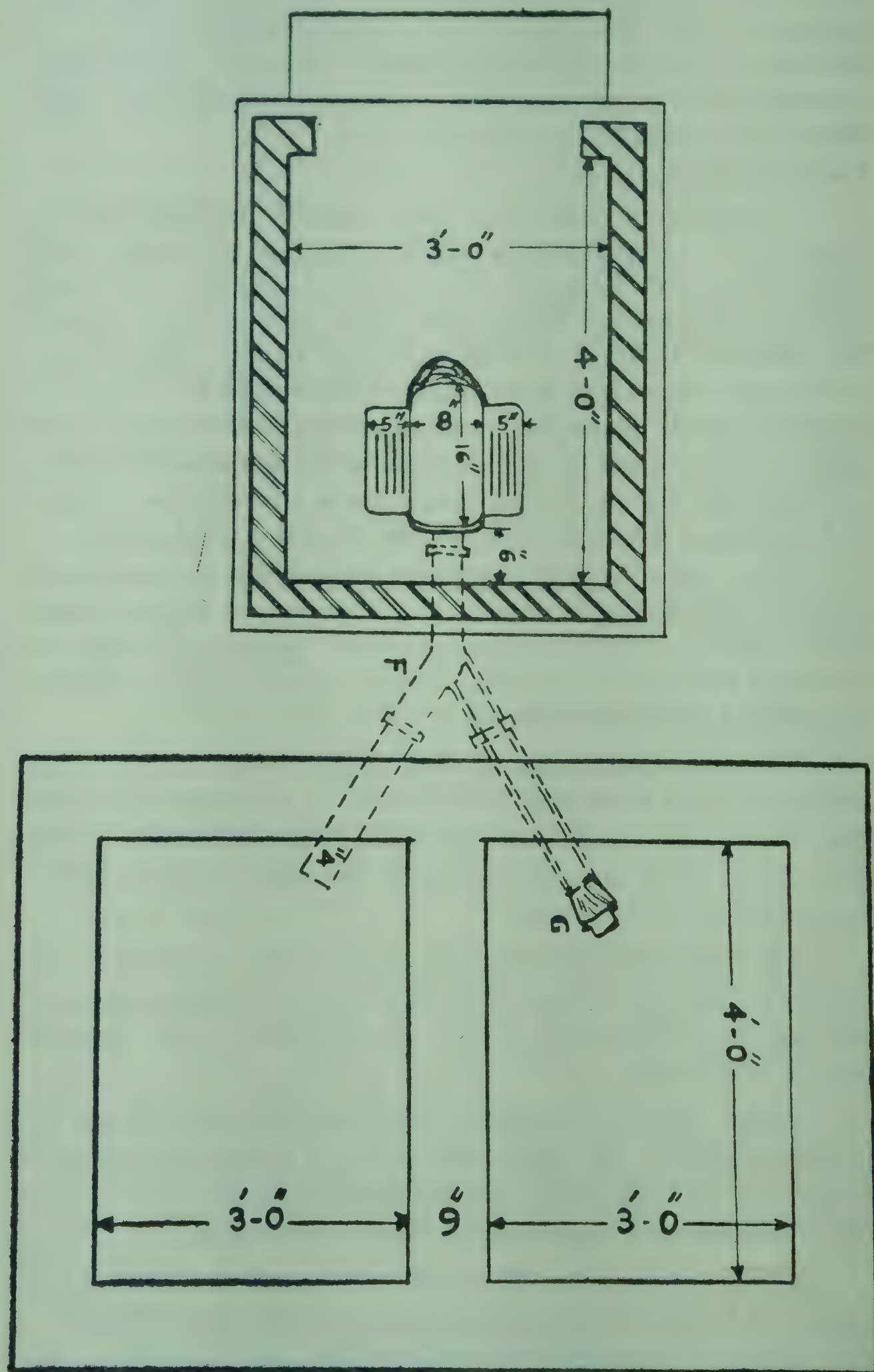
This latrine cannot serve the purpose in gravellous soil or where the water level is at only 5' to 6'. Where the suction capacity of the earth is less, the pit has to be cleaned every 5 to 6 years.

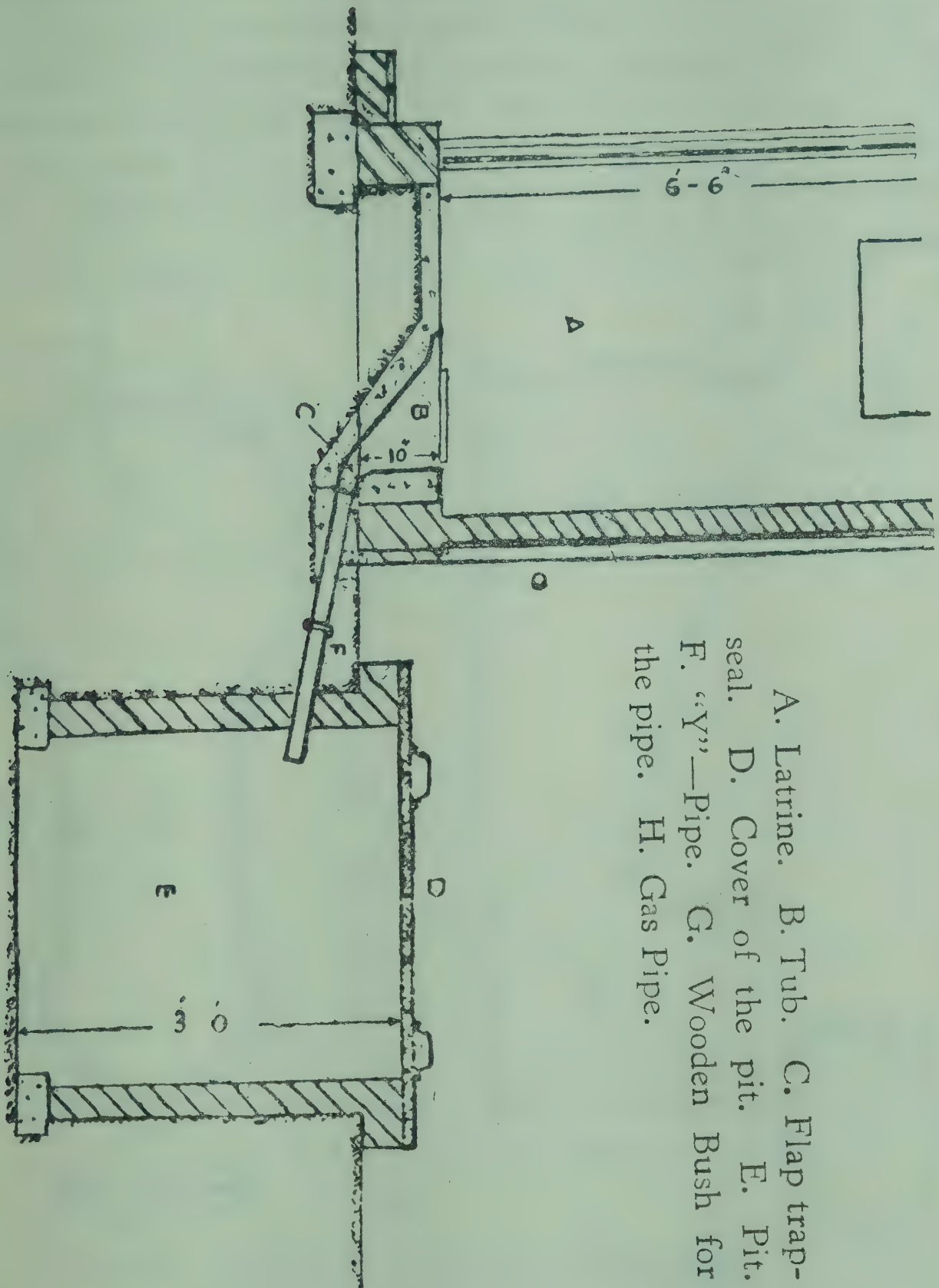
Water cistern should not be provided in the latrine for flushing purpose. By the abundant use of water, the pit will be filled up soon as the soil cannot absorb so much water. Two to three buckets of water can be used for cleaning.

Waste water from the bathroom and the kitchen etc. should not be allowed to go into this pit, as far as possible.

D.D.T., Phenyl etc. should be used sparingly for cleaning of this latrine.

CHAPTER—VI
SULABH SWATCHH SHOUCHALAYA
(Simple Sanitary Latrine)

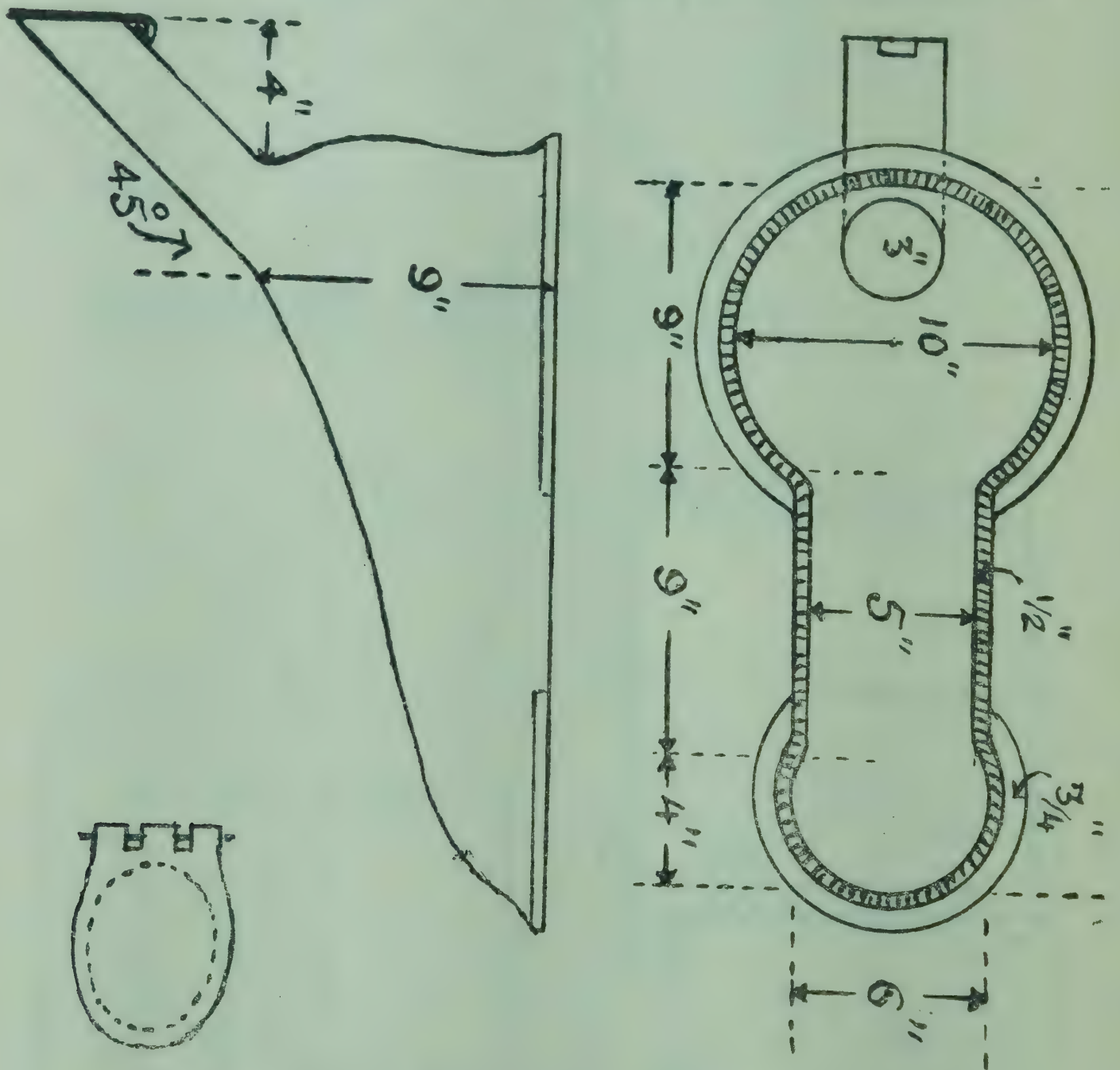




A. Latrine. B. Tub. C. Flap trap-seal. D. Cover of the pit. E. Pit. F. "Y"—Pipe. G. Wooden Bush for the pipe. H. Gas Pipe.

Sulabh Swatchh Shouchalaya is more useful for rural areas in view of the manure yielded by it. Dr. Kessel has prepared in Sevagram a long tub of galvanised tin with pipe for various kinds of latrines in the rural areas. A flexible black rubber diaphragm is fixed at the mouth of the pipe. This tin tub should be coated with coaltar. On account of the rubber diaphragm, it closes after the passage of faeces in the pit and

so flies do not flock there. The pit is $2\frac{1}{2}' \times 3' \times 3'$. It is filled with compost (waste material, leaves of trees etc.) and faeces, urine, waste water etc. flow into it. After the pit is full, the seat is transferred to another pit. The tub, however, gets rusted on account of urine, faeces etc. and the rubber gets loose and does not work. Shri Appa Sahib Patwardhan in



Simple Sanitary tub with flap

Gopuri Ashram has improved upon it by providing an earthenware pan with glazed glass and a tin flap instead of rubber diaphragm. A kachcha or pucca pit is dug behind it. The pit has to be provided with a gas pipe as the tub has no water seal. In the absence of a water seal it stinks and breeds flies and insects during the rains. Improvement is effected

in this latrine by inserting a long pipe and taking it 6" to 9" inside the back pit. By this means, the pit being dark the menace of flies and insects is obviated. This latrine is called the Simple Septic latrine.

After a few changes, the P.R.A.I. cement tub which can be flushed with a small quantity of water, along with its trap, has been made into the "Sulabh Swatchh Shouchalaya".

Construction

A one-foot high seat $3' \times 4'$ may be constructed and fitted with a tub and trap used in a P.R.A.I. latrine. One foot piece of a 4" pipe may be attached to the trap and connected to a "Y"—pipe. Two pipes $1\frac{1}{2}'$ to $2'$ long should be attached to each of the two prongs of the "Y" pipe to reach inside each of the two pits at the rear.

Construction of the Pits

Two pits $3' \times 4' \times 3\frac{1}{2}'$ with a 9" thick separating wall should be constructed. In the $4\frac{1}{2}'$ thick walls around the pits, five to 7 holes of $3" \times 4"$ dimension should be provided in every alternate layer. Earth should be used as mortar but the joints should be cemented. The last two layers of the walls in both the pits should be 9" thick. The floor should be paved with bricks, but should not be plastered. The top four layers of the walls around the pit should be thick. There should be no holes in them. The top two layers should be pucca so that rain water may not flow inside the pit and the cover may remain in position.

In many places, at a distance of 3 ft. from the latrine, two kachaha pits $2\frac{1}{2}' \times 2\frac{1}{2}' \times 6'$ are constructed leaving a space of $2\frac{1}{2}'$ in between them. The top one foot of the walls is laid with brick or stone. A pit lasts for six or seven years.

By digging two kachcha pits with their covers made of locally available material, still cheaper scavenger-free latrines can be constructed. Instead of a 4" pipe a cemented gutter may be provided for flow of faeces.

In rural areas where there is plenty of space and utility for manure, latrines of this type may be constructed. But it is difficult to build such latrines for manure in smaller towns. As far as possible, the pits should be properly arranged. The use of pipe in the place of gutter is essential.

Three-fourths of the pit is filled with waste material, grass and twigs etc. used in the preparation of manure. It is then covered and waste water allowed to flow in. The pit is dug according to the number of persons in the family providing 2 sq. feet of space for each. One pit lasts for six months to one year. After it is full, it is covered with earth and closed. The second pit is then used. Meanwhile, the compost in the first pit turns into good manure.

Faeces turning into water percolates in the soil through the holes in the pit. Plantains, Papaias, Coconuts, Mangoes etc. planted near the the pit get nitrogenous water.

A latrine with a kachcha pit costs Rs. 50 to 75 only, whereas one with a pucca pit costs Rs. 150 to 200. In rural areas, a latrine may be prepared at half this cost provided self-help and local material is used.

In view of water-seal trap, no gas-pipe is necessary. There are holes in the pit.

The process for the preparation of manure is the same as in the Septic Tank. Much water should not be used in this latrines. Phenyl and D.D.T. should not be used. A cement concrete cover according to the dimensions of the pit may also be provided.

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326, V Main, I Block
Koramangala
Bangalore-560034
India

CHAPTER—VII

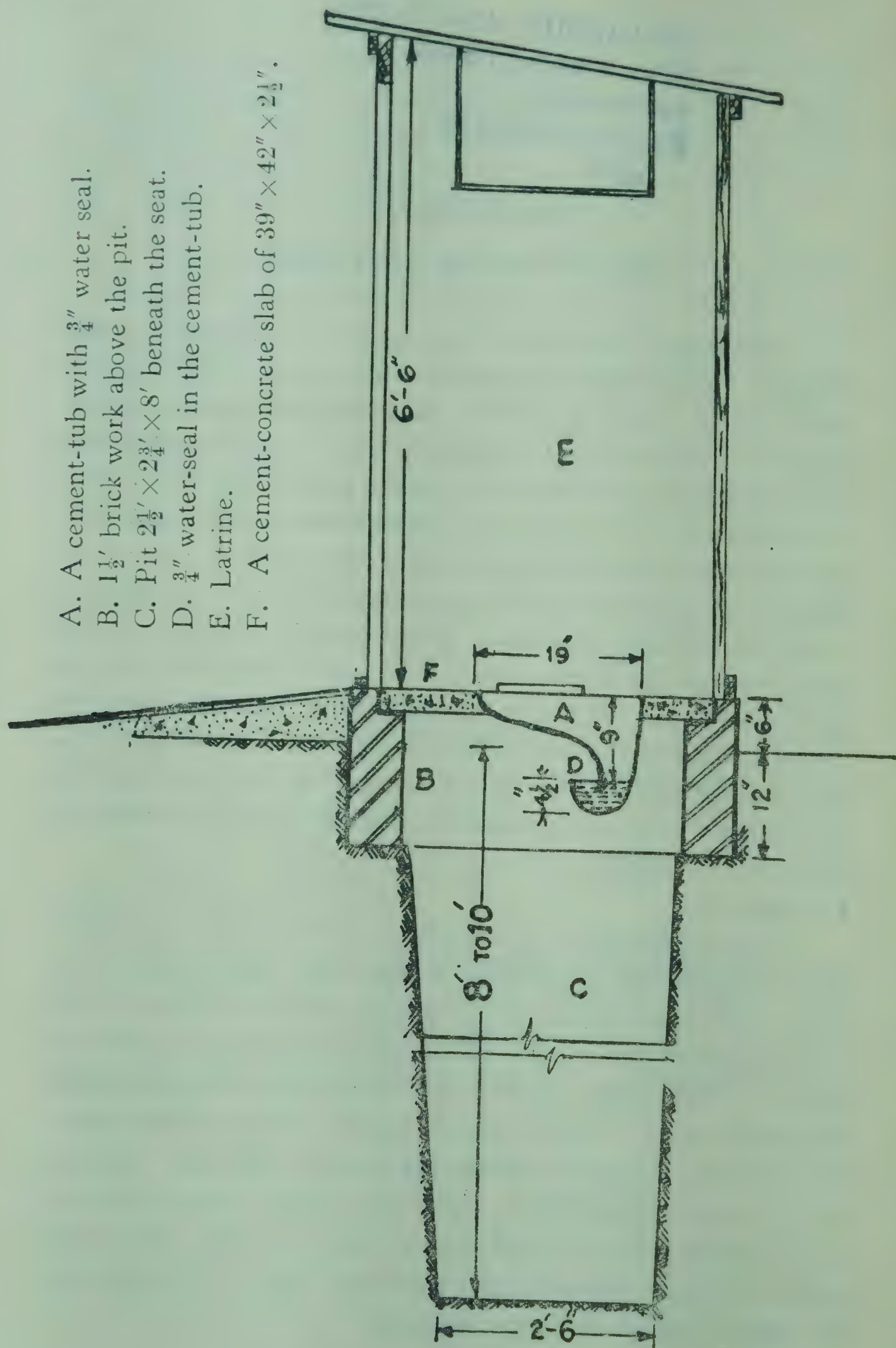
HAND FLUSH LATRINE

Generally, there is no provision for latrines in the villages. People ease themselves hither and thither in the open. This causes spread of diseases like typhoid fever, cholera, dysentery and hookworm etc. Eggs of hookworms present in a patient's faeces, lie on the ground and, in course of time, grow into hookworms. When these worms find their way in the bodies of others, they also suffer from the same disease. Very often, these worms get into the body through dirty food, water or milk. These worms also get into the body through the skin of those who walk bare foot on the ground. Hookworm and other contagious diseases can be kept under control by the use of this latrine. This is also free from flies, insects and filth. The scavenger is not required for cleaning it. This is a sanitary type of latrine and is really a boon to old people.

Latrine Pit

The pit should be at a distance of 25' to 30' from a well. Where the ground water level is high, this distance should be more. The dimensions of the pit should be 2'6" × 2'9" × 8'0". It should not be at a low level otherwise rain water will flow into it. The space around and adjoining the pit should be filled with earth. The pit should not be of bigger dimensions. It is built on the basis of slabs and should therefore, conform to the above dimensions. The top three layers of the pit should be built by 9" thick brick work so that earth from above may not fall in or rain-water get into it. It also helps the slab to remain in proper position.

- A. A cement-tub with $\frac{3}{4}$ " water seal.
 B. $1\frac{1}{2}$ ' brick work above the pit.
 C. Pit $2\frac{1}{2}' \times 2\frac{3}{4}' \times 8'$ beneath the seat.
 D. $\frac{3}{4}$ " water-seal in the cement-tub.
 E. Latrine.
 F. A cement-concrete slab of $39" \times 42" \times 2\frac{1}{2}"$.



Hand-flush latrine

Where the soil is sandy, the inner side of the pit should be lined with bamboo mats or a perforated unbaked brick-wall be constructed so that earth may not fall into it.

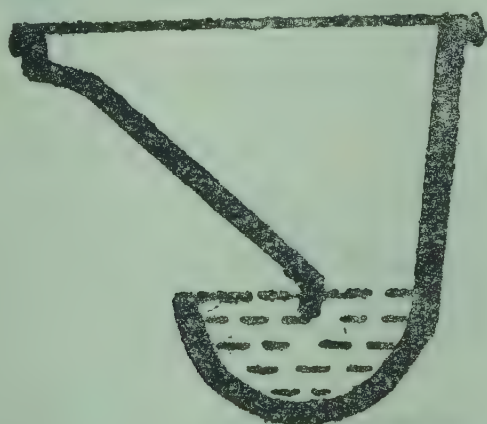
It is difficult to construct this type of latrine in gravelly soil.

One sq. foot of space per head is sufficient for a year. The faeces turns into water in the pit and gets soaked in the soil. The reaction which takes place in the Septic Tank, occurs here as well. Earth and minerals in the faeces solidify at the bottom in six or seven years. They can be removed and the pit used again. A foot high of earth should be strewn over this pit and then closed. The other pit should then be used.

A circular pit of 2' 9" \times 8' can also be used. Its top should be made in brickwork 9" high and 9" broad. If kacha pit is required, it should be like a bucket, so that earth may not fall in it.

Water Seal Pan (W.C.)

Moulds of cement-concrete and plastic are available for making this pan. It is made with 1:3 mixture of cement. Coarse sand should be used in its construction.

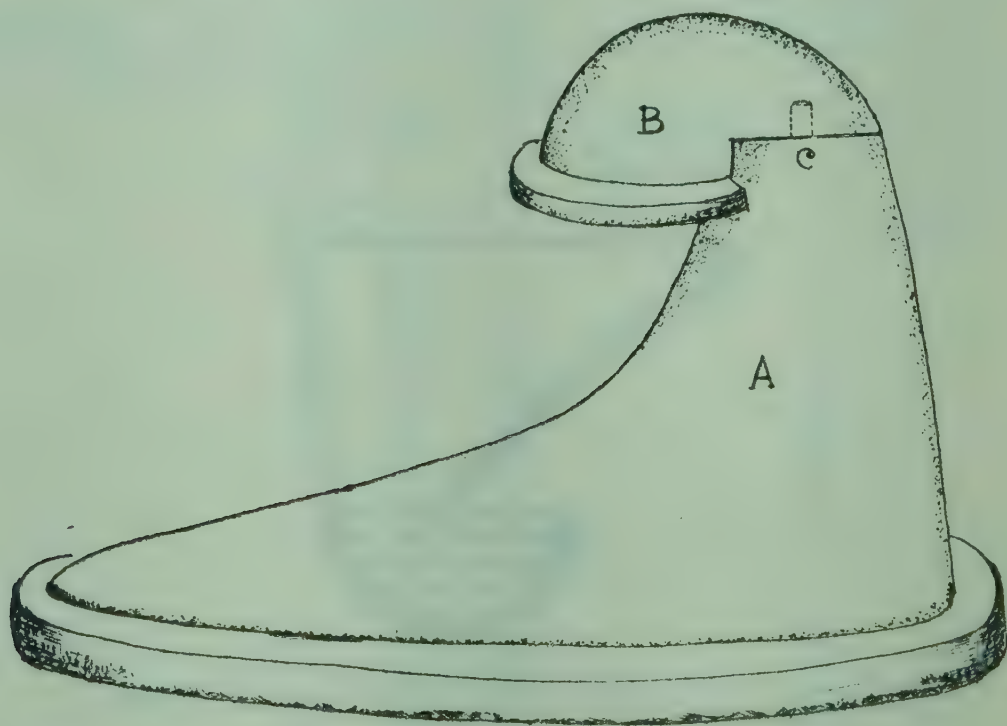


Water Seal Pan of Hand Flush latrine

The moulds of cement-concrete are in two parts, one is for the pan and the other, the top part, which is shaped like a cap, is for providing water-seal along with the pan.

The mould is first smeared with crude oil or used-mobil-oil so that the cement may not adhere to it. It is then given

a thin coating of cement which would keep the interior of the pan clean. If a coloured pan is required, the necessary pigment may be added to the cement. Later, a little water is added to the cement mixture to make it paste-like and then a $\frac{1}{2}$ " thick coating of it is given to the mould. When the lower part of the mould is ready, the upper cap-like portion is fixed to the lower mould as shown in the diagram. In order that the upper portion may remain in proper and stable position on the lower part, it is supported on small wooden stand. The second part should also first be given a coating of oil and cement and then the layer of cement mixture. In order that the upper part of the mould may come out easily, two pieces of paper are put on the lower mould near the water-seal portion. After 24 hours the pan should be levered out of the lower mould with the help of a thin iron plate or a chisel. Later, the second part of the pan should be removed carefully to prevent the water-seal of the pan from breaking. The pan will become strong if kept in water for three days.



Cement-Concrete mould of Hand Flush

The presence of $\frac{1}{2}$ " of water level at the bottom of the pan, prevents flies and stench. The pan has a length of 18" with a slope of 45° . It is 8" broad and 11" deep at the rear and 5" broad in the front. The passage for the faeces is 3".

Cement Concrete Pot

The pan is placed, as shown in the diagram, in a pit $18'' \times 12'' \times 15''$. A slab $39'' \times 42'' \times 2\frac{1}{2}''$ is made.

The pot is made of a mixture of cement, sand and $\frac{1}{2}''$ to $1''$ gravel in the proportion of 1, 2 and 4 respectively. Take iron rods of $\frac{1}{8}''$ thickness: four of $34''$ length, two of $16''$ and four of $41''$. The pan should be placed $\frac{1}{2}''$ lower in the slab so that water from the slab may flow inside it. The pan should be in the middle about $10\frac{1}{2}''$ from the rear portion of the slab. Foot rests $11'' \times 5'' \times 1''$ should be made at a distance of $18''$ from the rear. The distance between them should not exceed $8''-9''$. The slab should remain dipped in water continuously for ten days, and when ready it should be placed over the pit.



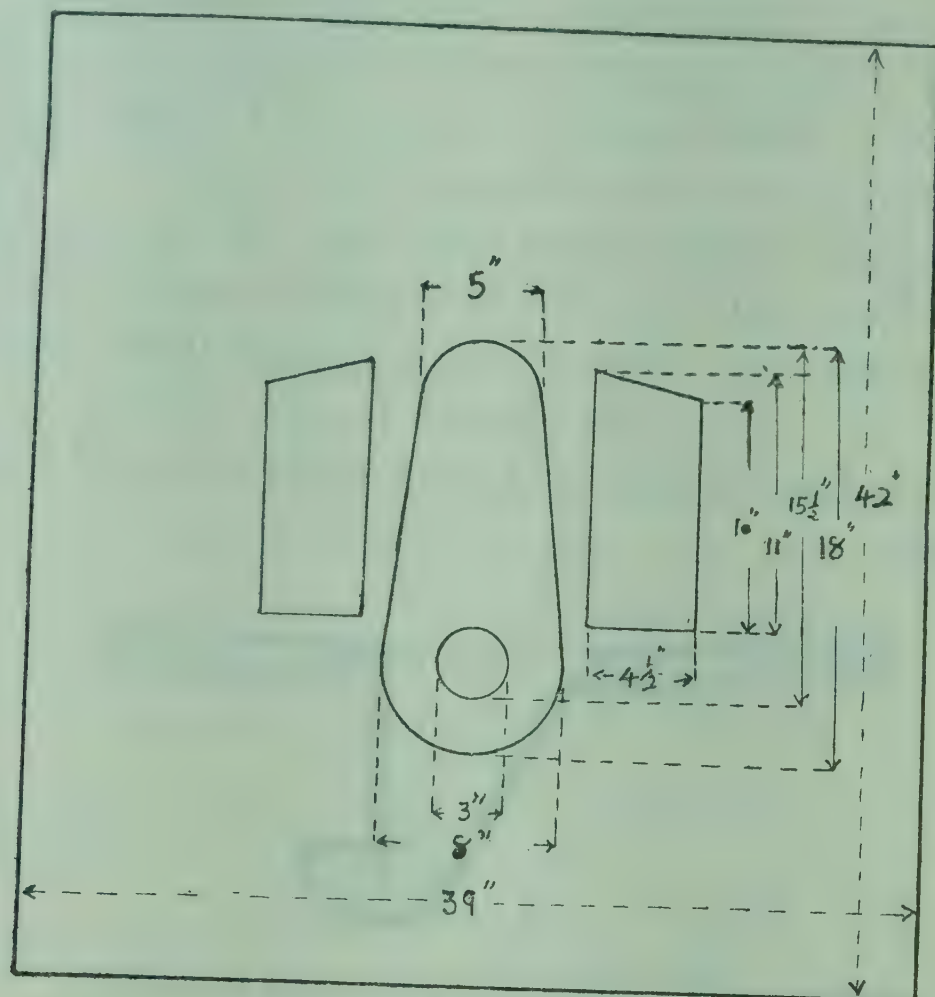
Reversed water seal pan with the slab

The second pan in which the water seal portion is reversed, is also made like this. Plastic moulds for this pan are also available with the Mitra Mandal, Village Improvement Centre, Village Rasulia P.O. Hoshangabad (M.P.). The pit and pan etc. are prepared in the above manner.

Preparation of Manure

This latrine saves us from flies, filth and stench. By converting the service latrine into this, a healthy neat and clean latrine becomes available. If manure is desired from faeces, then a pit $3' \times 3'$ should be dug up and $\frac{3}{4}$ of it filled with waste material, leaves etc. The slab should then be placed on it for use as a latrine. After five or six months, the slab should be removed and placed on the second pit. The

first pit should be closed after spreading one foot of earth over it. After removing manure, it can be used later on. If plantains, papawas etc. are planted on the adjacent land, they get nitrogenous water.



Cement Concrete Slab

Cost of the Latrine

This latrine can be constructed at a very small cost. It does not require a separate cover for the pot. The slab itself is placed on the pit and thus the expenditure on the cover is saved. Moreover, there is saving in space also. The slab and the pan of this latrine cost Rs. 15/- only. The pit can be dug up by oneself. The upper part requires 100 bricks. If the ground is hard, then even bricks can also be dispensed with. The roof covering can be built from the material locally available. It can also be built from bamboo mattresses, gunnybags or tin. The latrine can thus be built in Rs. 30-40 only.

Useful Information

(1) The pan must have a water-seal. With the presence of a little water in it, the stench and fly nuisance is removed. The 20 oz. of water in it works as a water-seal.

(2) A drum or earthen pot of water should be provided in the latrine for storage of water. Faeces should be flushed out after answering the call of nature by pouring 3—4 lbs. of water.

(3) The old "well-latrines" can be converted into clean and healthy latrines by fitting this type of pan in them.

(4) This type of pan can also be utilised in the Aqua Privy latrine.

(5) Service type latrines can also be converted into this latrine. The faeces can pass to the pit through a pipe attached to the bottom of the latrine.

This latrine can be built in the compounds of the houses in smaller towns where space is available. At seminars and meetings, this latrine may be used as a temporary latrine.

CHAPTER—VIII
MANURE—WELL LATRINE
(Khad Koop Sandas)

There are many factors contributing to the ill health of the villagers. One of these is their habit of easing themselves almost anywhere and every where in public places, near their homes and on the roads. This leads to the entire village turning into a rubbish heap. This is the cause of numerous diseases. The filth which causes annoyance to people and gives rise to diseases can be beneficial if utilized as manure. The family latrine is the solution of the problem of dirt and filth in the villages. The following points are worth mentioning in connection with village latrine :

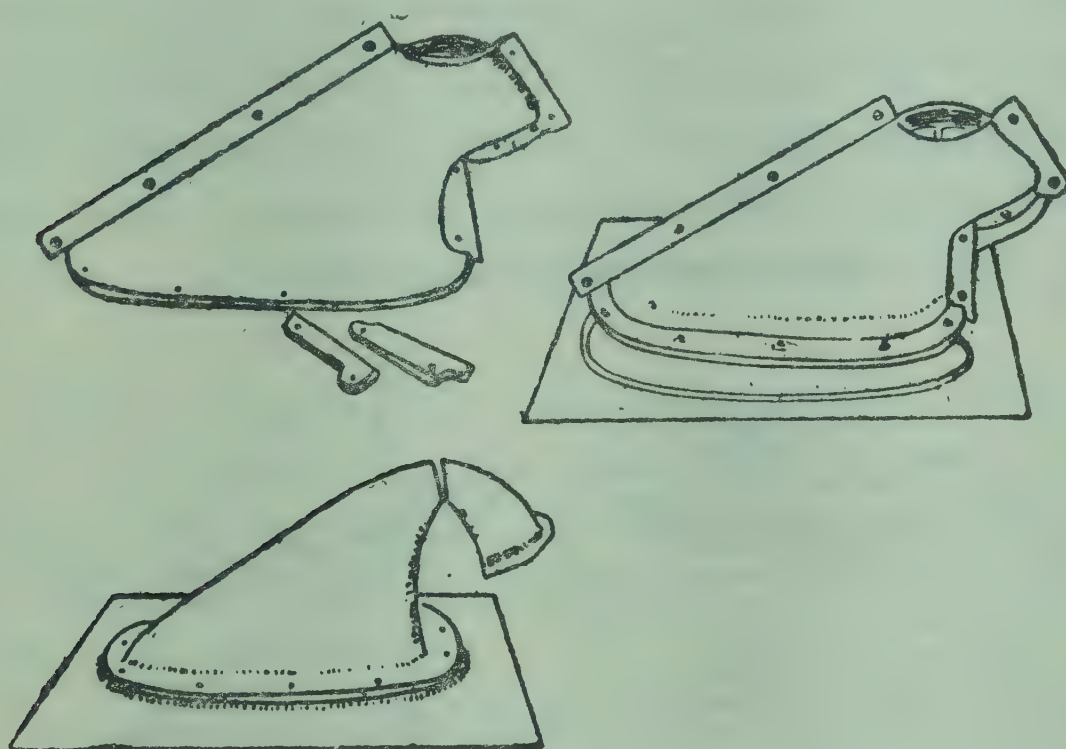
- (1) The site should not be soiled by the faeces.
- (2) Flies should not have access to the faeces.
- (3) The upper layer of the sub-soil water should not get contaminated.
- (4) The faeces should not be required to be touched by hand while cleaning.
- (5) Faeces should not give stench nor should it be open to sight.
- (6) The latrine should be inexpensive and simple.
- (7) Manure should be available from it.
- (8) If scavenging is necessary for the faeces, then it should not get mixed up with water and urine.
- (9) Faeces should not spread any disease.

Keeping these things in view, experiments in building of "sandas" were carried out under the guidance of Dr. Edwin Abbot of Friends Society Village Improvement Centre, Rasulia. These latrines are water-seal and their original design

was made on the basis of the guide-lines of the Ministry of Health, Govt. of India. A few changes have been made so that this latrine (1) can be made from cement locally, (2) may require less water, and (3) be cheap.

Design of the Latrine

Briefly, this is a "U" shaped well in which water remains upto a specified level even after the faeces have been carried away. This prevents the stench from inside the sandas-well from coming out and the flies cannot lay eggs.



Plastic Moulds

Construction

The latrine is made in two parts : (1) the well and (2) the seat. Later, these parts can be permanently joined if desired. Arrangement can also be made to detach the well when necessary.

Construction of Tub

A plastic mould is used for making the tub. This can be purchased from Friend Society Village Improvement Centre, Rasulia Distt. Hoshangabad (M.P.). Its present cost is Rs. 100/-.

The mould has three parts : (i) The outer fold; (ii) the inner fold and (iii) the neck portion. All the three parts should be separated by removing the nuts and bolts. There is the danger of bending of the plastic used in it. Therefore, a permanent structure for the inner fold should be made before starting the construction of the tub. For making permanent structure, the inner fold should be reversed and filled with cement mixture (one part cement, two parts sand and water as necessary). Before filling in the cement mixture, the sides of the bottom of the reversed inner fold should be smeared with grease, vegetable oil or castor oil. Allow two or three days to the mixture to harden. Either sprinkle water over it or remove it after 24 hours and place it in a water trough. This will become firm in three days.

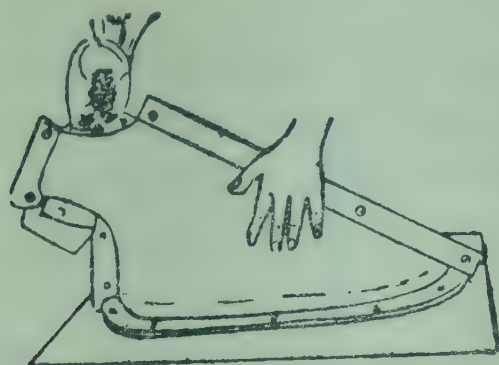


Seat of mould and process of preparing cement mixture

The inner side of the outer fold of the mould and the outer side of the inner fold and the neck portion should be coated with grease. Then join the mould and tighten the nuts and bolts. Then it should be placed on the cement slab already made. It will fit in snugly. It should be placed on a 2' x 2' pot.

Make a mixture of 5 lbs. of cement, 10 lbs. of sand and the requisite quantity of water. This mixture should be poured in the mould's opening. To remove air bubbles from

the mixture, the mould should be tapped while being filled up. It should be filled upto the brim.



(1) Filling cement mixture in plastic mould (2) Pan.

After twenty hours the hardened tub should be taken out of the mould. An easy way of removing it, without damaging the mould, is to unscrew the nuts and bolts and turn it upside down. Then by gripping the neck of the mould by the left hand slip off the protruding portion by force.

Seat

The seat should be circular as it is more convenient. It will be easier to make and move it from one place to another. It should be 39" in diameter and 2" or 2½" thick. It should slope towards the tub from all sides, so that water and urine etc. may flow into the tub.

If several seats have to be made, take an iron sheet 127" long, 2" to 2½" broad and two measures ("Suts") of thickness; punch two round holes of ½" diameter one each at a distance of 1" from each end; then the sheet should be bent into a circle and the ends fastened with a ½" nut and bolt. This will enable closing or opening of its mouth at will. In order to make the seat strong a network of 1 or 1½ measures (Suts) thick iron bars should be put inside it. The netting should not be very fine; two bars bent into a circle with three or four transverse ones will be sufficient. A mixture of one part of cement, two parts of sand three parts of ½" gravel should be used.

The entire open space of the tub except the mouth should be filled with cement mixture. In order that the specific

space is left for the tub, a 2" thick block of wood of the specified dimension is put into it. Leaving 15" of space at the rear, the mixture is poured.

In such a seat, the tub can be fitted and removed at will. It can be used for fixing a tub permanently to the seat. But it will be difficult to transport such a tub-attached-seat from one place to another. There will be lot of breakage.

Utility

The easiest and most economical thing is to fix this seat directly on a pit. For this purpose a pit 3'—4' deep and 32" to 36" in diameter should be dug. Place two layers of bricks around its mouth on the ground thereby making the top 6" of its surface pucca. The seat should now be placed and the tub set in it filling the joint with cement. The seat may be covered according to convenience.

Manure Making

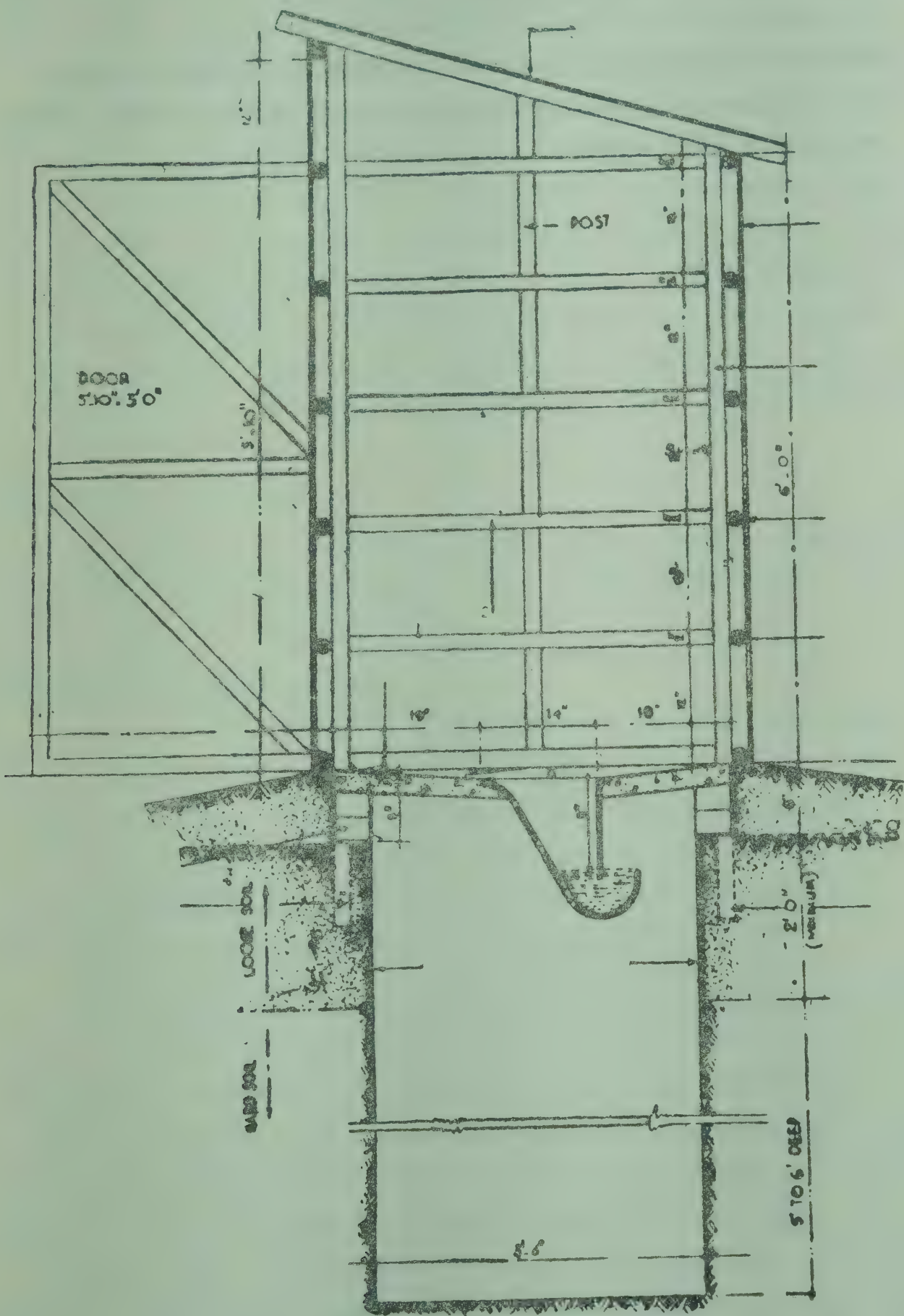
The following are the two methods of preparing manure :

(1) Choose a seat in which the tub can be easily fitted or detached and the pit can be filled up with waste material, grass and leaves etc. before the latrine is put into use. The other pit should also be prepared likewise. By the time one pit gets filled up the manure will be ready in the other which can be brought into service again after removing the manure.

(2) If a seat with a permanent attachment of tub is used and it is desired to fill the pit repeatedly with compost for manure, then there should be two seats. A shallow pit may be dug a depth of 2' to 2½' will be sufficient. It should be used till it is full. Then another pit with seat should be used. By the time this is filled up the manure in the first will be ready. This should be removed and thus the two latrines can be used turn by turn.

While the manure remains in the pit, plantains and papwas can be planted near it. They will automatically make use of the manure and water etc. of the latrine. If the latrine is cordoned off by date-palm leaves etc., then beans or similar

other vegetable creepers can be planted there. This will provide thick cover and give rich produce by using the manure, water etc.



Manure-Well Latrine

By using these latrines, enough manure for kitchen gardens becomes available in addition to cleanliness. This cleanliness and vegetables from the kitchen-gardens leads to the improvement of the health and economy of the village. This practice is followed on a national scale in Japan. As a result, manure worth Rs. 90/- crores becomes available to Japan. If this practice is put into use in India, it will provide manure worth Rs. 400/- crores.

COMMUNITY HEALTH CELL
326, V Main, I Block
Koramangala
Bangalore-560034
India

CHAPTER—IX

GOPURI LATRINE

The Gopuri latrine has been devised by Shri Appa Sahib Patwardhan. This latrine was started in the Gopuri Ashram in District Ratnagiri of Maharashtra and thus got its name. The Public Health Adviser, Maharashtra, Shri Krishna Dass Shah, after making many scientific improvements in it, got the State Government's approval, so that it could be adopted throughout the State. This latrine is good for the preparation of manure and is thus suitable for rural areas. This is of many kinds. We will here consider the Gopuri latrine for family use only.

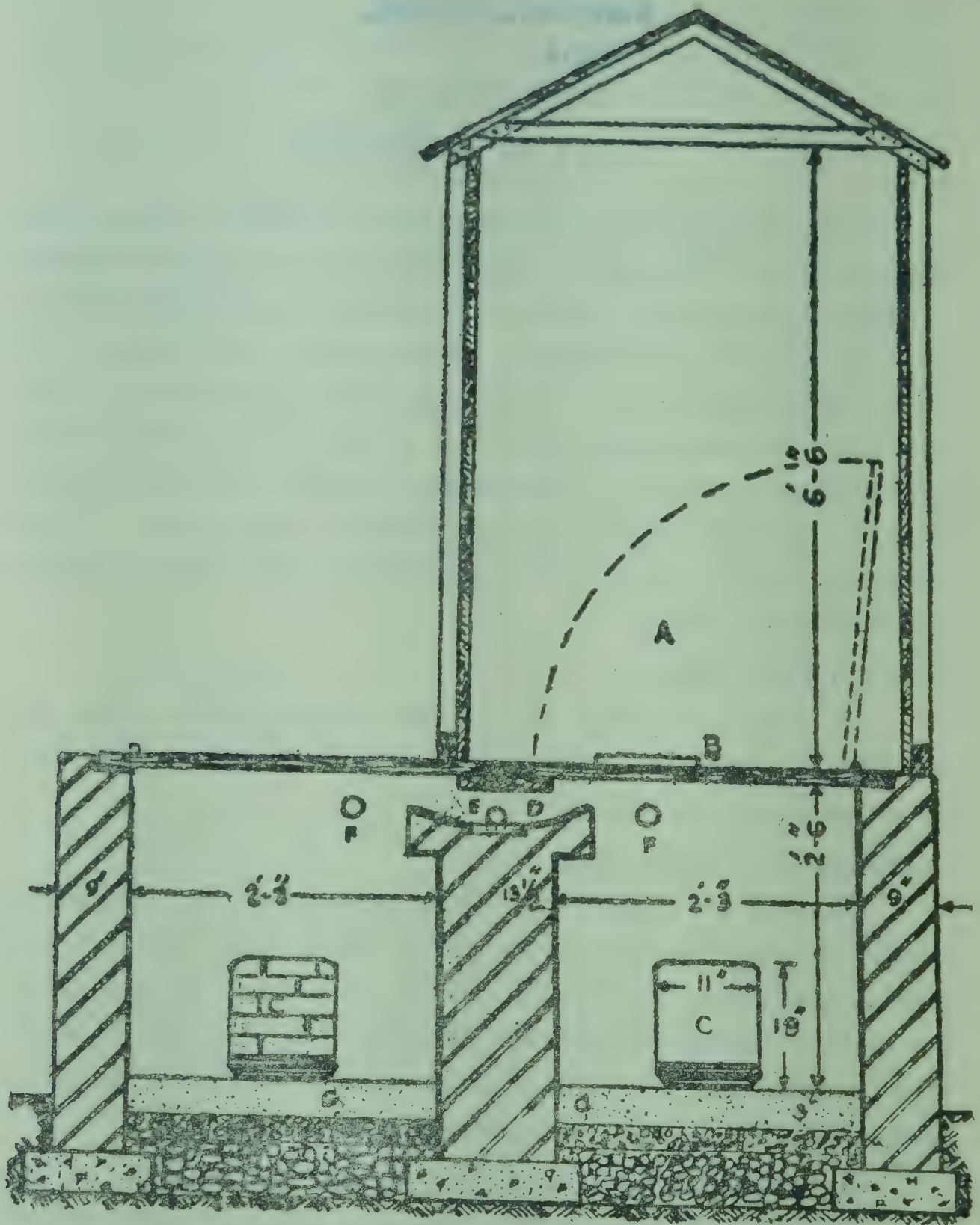
Site for the Latrine

A site $8' \times 4'$ near the house where water does not accumulate will be suitable. It can be built in the open space of one's compound.

Method of Construction

A pit $8' \times 4'$ and 9" to 1' deep should be dug. Six inches of the space at the bottom should be filled with brick gravel mixed with lime. Where the soil is gravellous, the pit should be only 6" deep. Two walls of brick 7'-2" long and 9" broad and two others 4' long and 9" broad should be constructed as in the diagram to make a rectangular tank of $7' 2" \times 4'$.

A 14" thick wall should be built in the middle of this tank, dividing the big tank into two parts— $2' - 6" \times 2' - 3"$. The four-walls should be raised 2'.3" from ground level. A window 11" wide and 1'-6" high should be constructed in the rear of each of the tanks for the removal of manure. These should be kept bricked up when the latrine is in use. Fix a 3" pipe in the centre of the rear portion of the 14" thick partition wall at the height of 1'.9" from the bottom when the



Gopuri Latrine

A. A tin or wooden enclosure around the seat. B. A seat of wooden planks on the tank. C. A window in the rear for removing manure. D. Sloping gutter between the two tanks. E. Outlet for water and urine. F. Air-inlet pipe. G. A layer of rubbish and earth at the bottom of the tanks. H. Hole in the wooden plank for gas-pipe.

two last brick layers of the four-walls are yet to be laid. This is for the passage of the water. When the wall in the middle is 1'.3" high then project the two layers of bricks by 3" on either side which will leave the tanks 2'-6" \times 2'-0" at the top. The gutter wall in the middle should be 21" broad. On both sides of the inlet pipe for water, 1' long 1½"—cement pipes should be attached to let air pass into the tanks. A jalli (network) should be provided in the rear portion so that rats, squirrels etc. may not go in.

Two steps should be constructed in the front portion of the two tanks.

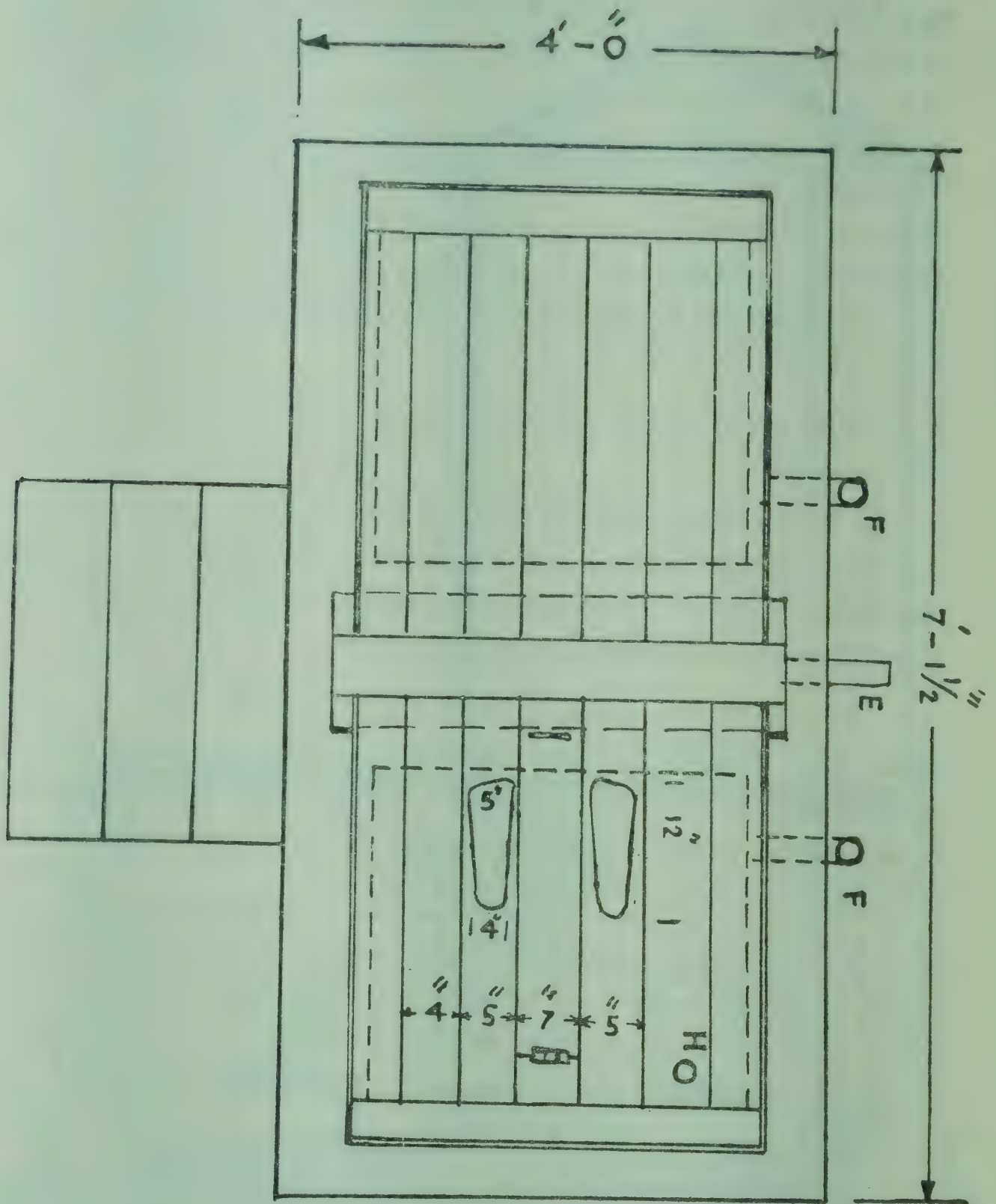
On the inner side of the Gopuri latrine only cement pointing should be done. The bottom should be paved with one layer of bricks. On the other side, it can be plastered in cement or lime or only cement pointed.

The gutter between the two tanks should have a good slope and should be smoothened with cement so that even a small quantity of water may flow down. The gutter should have a slope of atleast two inches and its channel should be "U" shaped when viewed from the side.

In order that a wooden plank may be placed an inch below the top brick layer of the two walls over the middle of the gutter, 2½" \times 1" grooves should be made. To provide a 2" grove all round the inner side of the top brick layer, an inch thick plaster should be done from above.

A seat for squatting on the tank should be constructed with wooden planks—one plank of 36" \times 7" \times 1" dimensions and four planks of 36" \times 4" \times 1" dimensions each. Teak wood or some other durable wood should be used for the purpose. A plank measuring 36" \times 5" \times 1" should be provided for the gutter to which a plank measuring 36" \times 2" \times 1" should be attached.

In one of the 4" planks, a 2" hole should be made at a distance of 3" from one end, through which a 2" cement or tin gas-pipe should be passed.



Tanks and seat of wooden planks

The 7"-plank be placed between two 5" planks. The 7" plank should be slit 6" at the rear and both portions refixed together with a 4" hinge or otherwise. The rear of the longer portion of the 7"-plank should be rounded and, as shown in the diagram, attached at both ends to the 5" planks with the help of pointed pins fixed one inch short of the ends.

The 5"-plank and the 6" portion of the 7"-plank should be placed between the two 5"-planks and a baton of $13" \times 3" \times 1\frac{1}{2}"$ measurements should be fixed in the rear portion at a distance of 3" from the edge. This baton would join the 3 planks together to form the seat and the middle 7"-plank would serve as the cover to which handle should be fixed in the front portion.

Foot-rests of $12" \times 4" \times 1"$ dimensions should be made on both the 5" planks at a distance of 15" from the rear. This seat when ready, should be placed on one of the tanks. This will rest on the cover of the gutter on the one side and on the wall on the other. The other planks should be placed along the seat so as to cover the tank. A tin cover should be placed on the other tank.

The latrine can be screened off by a $4\frac{1}{2}"$ wall, tin sheets or any other material available and according to one's means.

The Gopuri latrine can be built with stone if bricks are not available. The walls, in that case will be 15" broad.

Estimates of Expenditure and Equipment

Here, we will consider the estimates for the expenditure on the construction of the two tanks and the equipment required for it. The super-structure can be constructed from the available material according to one's means. The cost of construction of the lower portion upto the two tanks will be Rs. 100/- only.

<i>Material</i>	<i>Measurements of planks for the seat</i>		
25 cu. ft. brick pieces	$36" \times 5" \times 1"$	—	Three
750 bricks	$36" \times 7" \times 1"$	—	One
$1\frac{1}{2}$ bag cement	$36" \times 4" \times 1"$	—	Five
4 ft. long 2"—cement pipes	$36" \times 2" \times 1"$	—	One

A mason and two labourers will be required to work for two days. Mud will be used as mortar for the latrine and pointing will be done with cement. The gutter in the middle should be pucca.

The covering over the latrine and both the tanks should be done on $1\frac{1}{2}$ " thick brick wall. Leaving 1' to $1\frac{1}{2}$ ' open space on top, erect 9" \times 9" pillars two in the front and three on the back. This open space will admit light and air in the latrine. The cover above should have a slope backwards. It can be built with tiles or cement sheet. A gate measuring 2'-3" \times 5'-6" should be provided between the two tanks. Thus the cover etc. costs Rs. 150/-.

Necessary Information

(1) The tanks should not be of bigger dimensions otherwise the cost of the cover will increase and the faeces will go on accumulating without spreading leaving half the tank empty. When faeces, earth etc. fall in the middle portion only, the front and rear portions remain empty. Therefore the portion adjacent to the gutter should not be longer than 2'-3".

(2) In both the tanks, manure is processed by aerobic bacteria. They live on the oxygen of the air. Therefore, inlet pipes for air are provided in both the tanks. The mouth of this pipe should be closed with fine netting so that rats, mosquitoes and flies may not get inside it.

In the process of putrefaction of faeces some gas is produced. To provide an outlet for it a 6" long pipe is fitted in a 2" hole in a plank. Since the gas produced inside is lighter than outside air, it gets out through the pipe. This will ensure quick processing of manure and the latrine will remain free from stench.

(3) The inside of any of the tanks should not be plastered with cement. The processing of manure will slacken by cement plaster. Therefore, only pointing should be done. The bottom of the tanks should also be paved with a layer of bricks and pointed. The outside may either be plastered or pointed.

(4) Faeces in the latrine should be covered by ash, crushed dry leaves, husk, straw and earth etc. Earth alone

does not completely cover the faeces. It also does not absorb all the water. It, however, helps the aerobic bacteria. They multiply on earth and process the manure with its help. Ashes and other organic matter, even in a small quantity, cover the faeces properly. They absorb the water used for ablution. Gases formed in the process of putrefaction get absorbed in the interstices of grass and leaves etc. and the earth spread over it prevents stench. Moreover, good manure is also produced.

(5) The water which gets into the tank along with faeces is enough for manure. Therefore, extra water should not be allowed to get in else it will give out stench. The water used for ablution and urine is therefore, allowed to go out through a pipe. Sometimes, germs of diseases like hookworm, typhoid etc. are found in the faeces. On account of aerobic action in the tanks much heat is generated in the production of manure. It being unfavourable to them, the germs die out. The manure from Gopuri latrine is good. It yields black, soft and light manure.

Use and Care of Latrine

(1) Only one of the two tanks should be used at a time. The other should be used after the first is full and thus the process will continue. For a family, one tank is sufficient for three months. During this period, manure is ready in the other one and it should be removed through the rear window.

(2) Before using the latrine, spread crushed grass and earth at the bottom of the tank upto 3" so that water, if used in excess, may not flow out.

(3) The middle plank of the seat over the tank which serves as the cover should be closed after easing. The other planks should also be kept closed.

(4) Place a cover over the other tank and use it for keeping earth, ash, chaff etc. to be used for covering the excreta after easing.

(5) Do not let too much water get into the tank. If it does, then spread enough ash, crushed dry leaves etc. in the tank. If it starts stinking owing to too much water, then a little lime or gamaxine should be spread over it.

(6) Flies lay eggs inside the tank if the cover of the tank is negligently left open or the latrine is not properly built. In such a situation if white larvae are seen, these should be destroyed at once by spreading Gamaxine powder, B.H.C., T.C.L. or kerosene oil over them.

Where the soil is not hard or gravellous, the Gopuri Latrine can be used by digging two underground tanks. Only the top three layers should be made pucca. The gutter in the middle should be made pucca. In this way the cheapest possible latrine can be built. But manure from this tank can be removed only by getting down into it. The tanks can be made pucca by lining them with $4\frac{1}{2}$ " bricks and pointing them instead of plastering.

The moveable latrines of Gopuri serve as good public latrines. But public latrines demand more care. These may be brought into use if the village panchayat looks after its cleanliness and people are trained.

Its distinguishing feature is an arrangement for the flow of effluent in such a way that the effluent-manure can be removed after three or four days by taking out the cover of the outlet pipe.

In Maharashtra the Naigaon latrine is extensively used. It yields manure as well. The State Government has accorded recognition to it. The Maharashtra Gandhi Smarak Nidhi also gives a grant of Rs. 50/- to the family which builds this latrine. It has been evolved by Shri Navrekar. This is known as "Naigon latrine" after the name of the village where it was evolved.

Information about the Latrine

This should be constructed in the presence of its specialists. Once its construction is understood it is easy to construct these latrines.

This latrine is made proportionate to the number of users. Difficulties arise if a smaller one is made and it is not easy to modify them. Space should be provided at the rate of $1\frac{3}{4}$ cu. feet, per head. There is no harm if it is slightly bigger but it should not be smaller.

This latrine is simple and economical in construction and a source of good manure. It produces manure worth Rs. 70 to 75 in a year which can be directly put in the fields. This is free from stench and germs. Its construction costs Rs. 300-500.

The effluent from this latrine flows out automatically. It can also be let off in drain or a compost pit or be carried off to the fields in buckets.

This latrine is mounted directly on the pit and therefore involves less expenditure and space. The size of the tank can be varied according to the number of persons using the latrine.

The number of users and the corresponding sizes are given below :—

No. of users	Size of the tank			No. of latrines
	Length in ft.	Breadth in ft.	Depth in ft.	
10	$3\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	1
12	$3\frac{1}{2}$	3	$2\frac{1}{2}$	1
16	4	3	3	1
20	4	$3\frac{1}{2}$	$3\frac{1}{2}$	1
30	6	$3\frac{1}{2}$	$3\frac{1}{2}$	2
40	7	4	$3\frac{1}{2}$	2
60	11	4	$3\frac{1}{2}$	3

Construction

Select a piece of land 6 ft. long and 5 ft. broad and dig it to 1 ft. depth. Then, all around it, dig 15 inches broad and 24 inches deep foundations. Adjacent to this foundation and joined to it on one side make a pit $2' \times 3'$ and 3' deep.

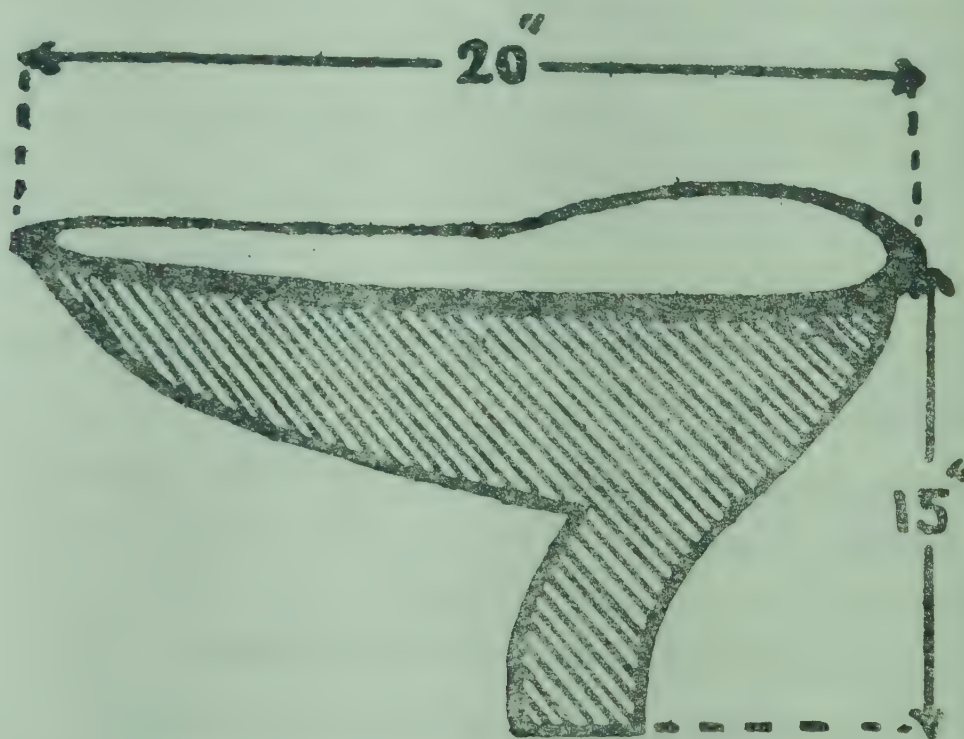
2'—9" foundations should be laid with pieces of stones or brick-gravel in the $6' \times 5'$ space. The other portion should also be filled up to the height of the foundation.

The $6' \times 5'$ space should be cemented upto 3" by a 1:2:4 cement-concrete mixture. The back $2' \times 3'$ portion should also be made likewise but this space should be kept 6" lower than $5' \times 6'$ space. Use $\frac{3}{4}"$ to 2" gravel for making concrete.

In the space measuring $6' \times 5'$, a tank of $3\frac{1}{2}' \times 2\frac{1}{2}' \times 2\frac{1}{2}'$ dimensions should be made with stone or brick. The wall should be 14" thick. A hole $8" \times 6"$ should be provided in the middle of the rear bottom portion of the tank. A smaller tank measuring $15" \times 15"$ should be constructed in the $2' \times 3'$ portion so that it touches the bigger tank. At a height of 3" from the bottom of the smaller tank, a gate valve of 2" diameter may be fixed. This valve may be made by joining a galvanised pipe or, alternatively, a piece of pipe may be

attached there and closed with a plug. The two tanks should have the same height. On one side of the smaller tank at a distance of $9\frac{1}{2}$ " from the top, a 15" long cement pipe of 3" diameter may be attached.

The two tanks should be plastered with cement both inside and outside. The inner corners should be rounded. The tanks should be filled with water and checked for leakage.



Naigaon Latrine Pan

A cement-concrete slab to be placed on the tank should be prepared separately on the ground. Prepare two slabs of $4' \times 7'$ and 3" thick. For fixing a gas pipe, a 2" hole should be made towards the end of one of these slabs at a distance of 4" from its outer edges. A third slab $48" \times 20"$ and 3" thick should also be prepared. At a distance of 12" from one end of this slab a pan of 20" or 22" should be so attached as to be equi-distant from the other two sides.

Another slab of $18" \times 18"$ and 2" thick should also be prepared for covering the smaller tank. Keep these slabs under water for 10-15 days.

Construction of the Latrine above the Tank

An enclosure measuring $4'-1" \times 3'-1"$ with 9" wide walls should be made over the bigger tank. A door measur-

ing $5\frac{1}{2}' \times 2'$ and a transverse window measuring $2' \times 1\frac{1}{2}'$ should be made. Four steps measuring $10'' \times 7''$ should be built.

The slabs should be placed on the tank when they have become firm. The slab with the pan should be placed in the middle and 7" slabs on the sides. Footrests $10'' \times 5'' \times 1''$ be constructed on either side of the pan. Fix a 10' long cement pipe of 2" diameter for the outlet of gas. The whole of the latrine should be plastered from within. The lower portion of the 15"-high pan should remain immersed in water by 3".

Before using the latrine, the tank should be filled with water. Three to four buckets of a solution of dry cowdung in water should be poured in the tank. Before easing, every person should pour some water in the pan so that faeces may not stick to it. This will ensure that faeces drop down straight into the water and the latrine remains clean and stench free.

Material used in the Naigaon Latrine

1. 4 cartloads of pieces of stone or bricks (87 cu. ft.).
2. 1 cartload of $\frac{3}{4}''$ to 1" gravel (15 cu. ft.).
3. 1750 bricks,
4. 10 bags of cement.
5. Gate-valve of 2" diameter.
6. 10 ft. long cement pipe of 2" diameter.
7. A 20" long and 15" deep tub. The tub used in Aqua Privy can also be utilised.
8. A 15" long galvanised pipe of 3" diameter.
9. A door measuring $6' \times 2\frac{1}{2}'$.
10. A window measuring $2' \times 1\frac{1}{2}'$.
11. 60 ft. of $\frac{3}{4}''$ thick iron bars.
12. Cover for the latrine.

Estimated Expenditure on the Naigaon Latrine

1. Excavation of foundation etc.	6.50
2. Concrete for foundation and other purposes	22.50
3. Cement concrete for the bottom of the tank	18.00

4.	Brickwork on innerside of the tank, the latrine and the smaller tank	216.00
5.	Slabs	18.00
6.	Stair-case for the latrine	10.00
7.	Door and windows	72.00
8.	Tub	12.00
9.	Gas pipe	15.00
10.	15" long Galvanised pipe of 3" diameter with coupling and plug	7.50
11.	Cover for the latrine and miscellaneous expenditure	80.00
12.	Colouring and sundry expences	22.50
Total		<hr/> 500.00 <hr/>

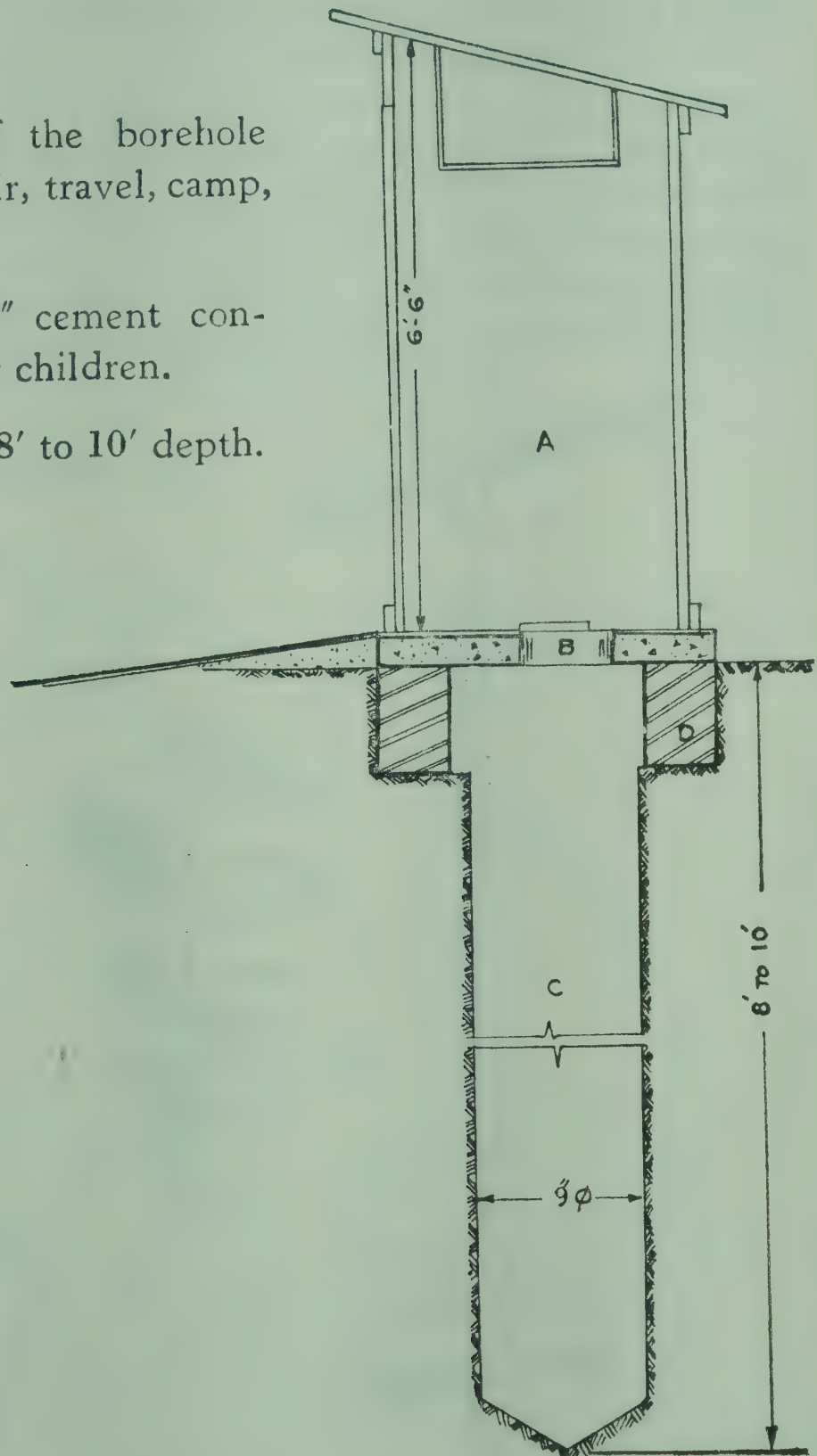
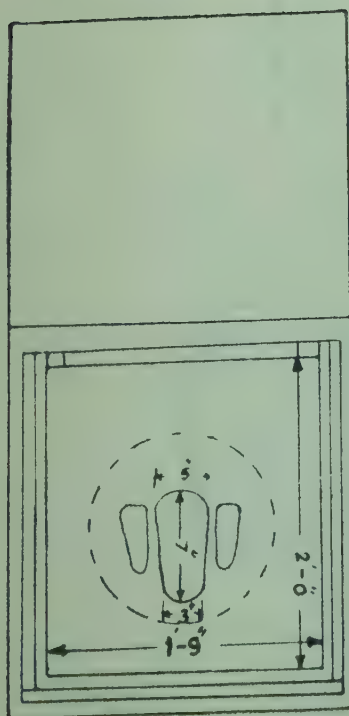
The cost may vary according to local rates.

CHAPTER XI

BOREHOLE LATRINE

Where the space available is very little, a borehole type of latrine can be constructed.

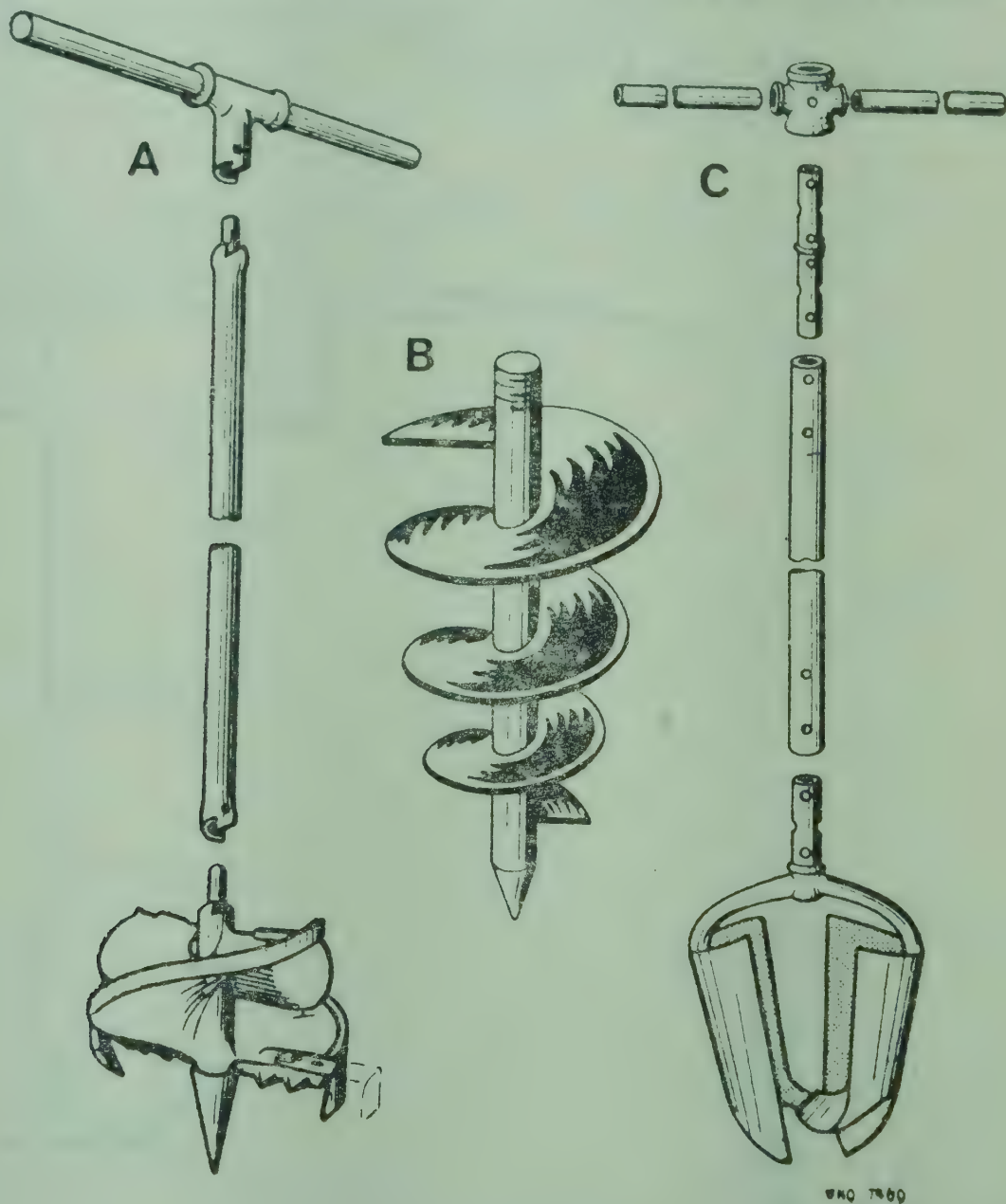
- A. Enclosure of the borehole latrine for fair, travel, camp, family etc.
- B. $2' \times 1\frac{3}{4}' \times 2''$ cement concrete slab for children.
- C. A 9" hole of 8' to 10' depth.



Borehole

Earth-Auger

Holes from 9" to 14" diameter can be drilled upto 20 feet by manually-worked earth-augers. Augers are of various types. It is very easy to bore a hole in loamy and sandy soil. A small pit should be made at the site, where a hole has to be bored, and some water poured into it. The earth-auger should, then be used to bore the hole rotating it with mild downward pressure. The lower part of the auger is conical, as shown in the diagram. This cuts through the damp soil and the earth automatically rises to the upper portion of the auger. The auger is taken out after it is full, and the earth is removed. It is then replaced in the hole and the boring process continued.



Various kinds of borers

A. and B. Borers for hard soil. C. Borers for normal soil.

As a result of pouring water in the pit, earth does not slip out of the auger but becomes smooth and does not fall in

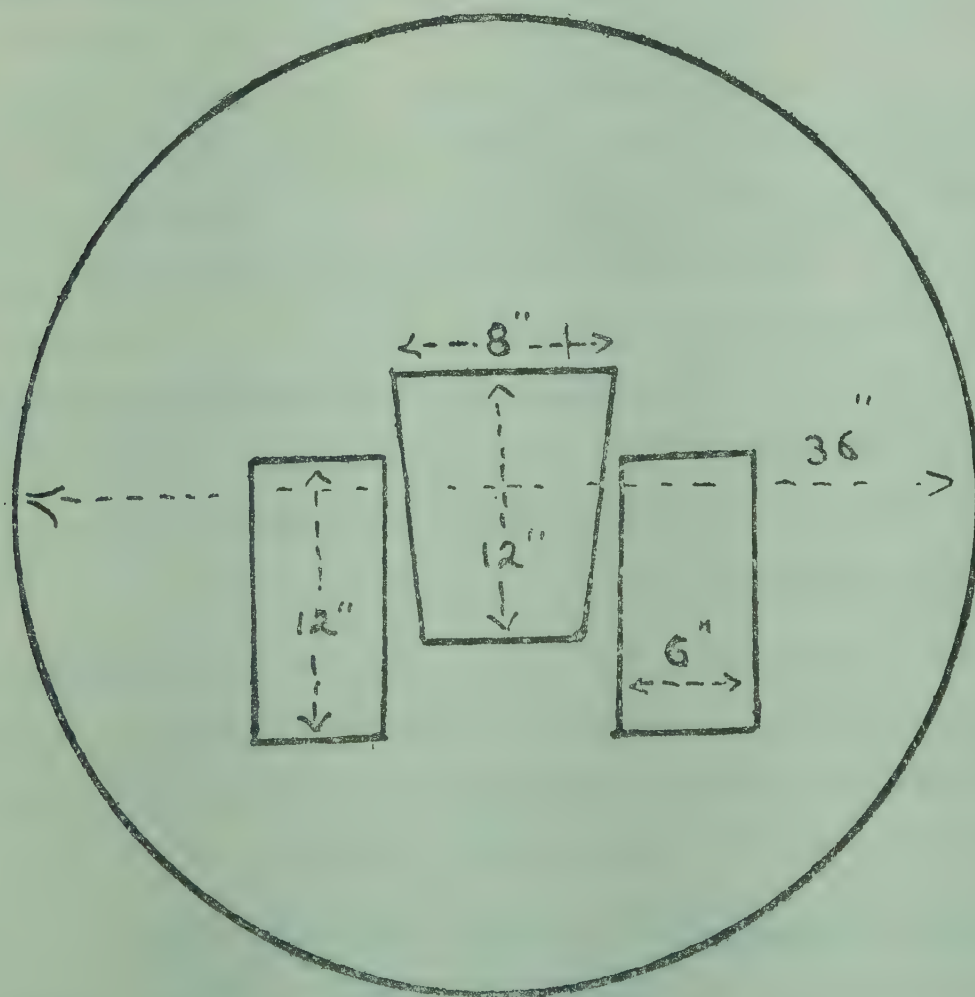
the hole. The earth auger can be adjusted for making bigger or smaller holes. Where the soil is rocky and gravellous, some difficulty is experienced in boring the hole. But for making a hole in such a soil screw type borer is available. Borers of various kinds can be had from the agriculture Deptt. They are also available in shops trading in agricultural implements. Borers can also be obtained from the Health Deptt.

Construction of Latrine

A hole having a diameter of 14 inches and a depth of 15 feet can adequately serve a family of six or seven persons for a year. Where two holes are required, the other hole should be bored near at hand and its mouth closed with a cover. The second can be used when first is filled up. The depth should not reach the water-level because of the possibility of the well water getting contaminated. There is no difficulty where the water level is very low. It would be better to make the hole at a distance of 25 feet from the drinking wells.

The Seat

A circular seat of 36 inches diameter and 2 inches thick may be constructed with cement concrete mixture prepared in the proportion of 1:2:4.



Circular seat of cement concrete

In constructing the seat a network of 2--gauge bars should be used for giving it strength. The details of the method of construction of the circular seat have been given in the chapter on manure-well (Khad Koop) latrine. The seat should have a slope towards the centre from all sides with a hole $12'' \times 7''$ in the middle. Foot-rests should be made as shown in the diagram. Where a direct hole is not wanted a water seal latrine can be constructed by fitting a tub of the hand-flush or manure-well latrine. Before placing the seat on the hole, the upper portion of the latter should be built with 9" thick brick work so that earth may not fall in from above.

Enclosure

Enclosure for the latrine can be made from local material. A cloth canopy over a wooden framework or matting over a few bamboo poles can also serve the purpose.

Preparation of Manure

Where there is enough space, 4 to 5 feet deep holes may be dug up at different places for this purpose. It is better to pour some earth over the faeces after easing. When one hole fills up, the seat can be moved on the other for use. By the time the second hole fills up, the manure is ready in the first one which can be taken out by the earth-auger after three or four months. Where trees are to be planted, holes may be bored with the earth-auger and used as latrines. When full, the holes should be closed by pouring a foot of earth on each and trees planted there after a month or two.

Use of the Latrine

This latrine can be used mainly in training camps, at conferences, fairs, and for the old and the sick. Some difficulty is experienced in constructing this type of latrine where the soil is rocky or the water level is high.

Latrine for Children

Children ease themselves on the road and spread filth. The proper thing will be to get them habituated to easing

themselves in their own latrines. But owing to the bad condition, big seats and filth of the family latrines, children do not want to use them. In view of this, bore-hole latrines can be made in the courtyards or a little farther off along the road in much less space. Holes should be bored and seats placed on them. There is hardly any necessity of an enclosure.

Eight feet deep holes of 9" diameter should be made for the children. Four or five such latrines should be dug close to each other, as smaller children like to ease together. If there is an open courtyard for the family only one latrine is sufficient for the children. It requires 1-6" \times 2'-0" space.

A cement-concrete slab of 1'-9" \times 2' \times 2" dimensions should be placed on the latrine. Leaving a 7" \times 5" hole in the middle, foot-rests be constructed.

If the latrine is in an open, sunny area it will not stink. Some earth should be sprinkled once a day. Generally children do not use water for ablution, hence there will not be any filth.

This latrine is helpful in making the children habituated to the use of latrines. To avoid the present-day filth on the roads, child-commodes should be constructed at the corner of lanes.

To obviate the flow of rain-water in the holes, their upper portion should be in brickwork. The cement concrete slab should be placed on a platform 6" to 9" above the ground level. The platform's height should be such that children can easily step on it.

COMMUNITY HEALTH CELL
326, V Main, I Block
Koramangala
Bangalore-560034
India

CHAPTER—XII

THE IMPROVED LATRINE

The latrines in vogue at present are, by and large, of the service type. Even these are not alike throughout the country. In the South, the latrines built in a corner of the compound are not provided with pans. The faeces fall on ashes or earth. One has to go through the window to clean it. In Madhya Pradesh, the latrine is by the entrance. Receptacles are provided in the latrine, but instead of the proper pans, useless or broken utensils are placed. People do not take into consideration the sweepers' inconvenience and trouble. Faeces have to be cleaned from outside, without entering the house. In the northern provinces like the Punjab, oven-like latrines are built on the roofs. Pans are also not provided. The faeces fall on the floor, for cleaning which the sweeper has to go through the entrance.

These latrines require many improvements. Among the improvements which can be brought about, more attention should be paid to the following. If these are carried out, the trouble at present faced by sweepers will be eliminated.

(1) Pans of specific size must be placed in the service latrines, irrespective of their type.

(2) Water must be provided to the sweeper for cleaning the pan.

(3) The construction of the seats should be improved so that urine and water do not mix with faeces nor fall into the pan.

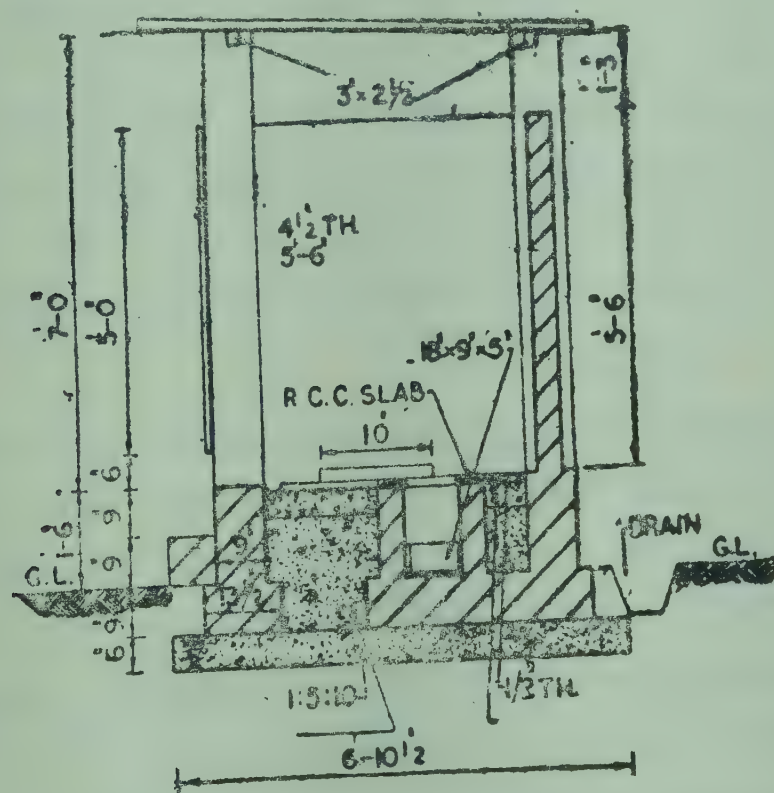
(4) The floor where the pan is placed should be pucca so that water, urine and faeces falling on the ground may not putrefy there. It should also have a little gradient.

(5) The place where the pan is placed should not be large or deep inside. If it is deep the sweeper has to enter much inside the filth. If it is large, the pan does not lie at the specific place and the faeces fall on the ground.

(6) The place where the pan is kept, should be closed so that it may be out of sight of the passers-by and pigs etc. may not enter and spread filth. Where there are large windows, they should be provided with doors and kept clean.

(7) Soakage pit or drain should be provided for water and urine etc. They should not remain there.

(8) The entire latrine should be washed with water once a week and sprayed with gamaxine or some other germicide.



Improved Latrine

(9) Liquidation of Jagirdari is essential. Only one Institution (Municipality) should have the responsibility for their cleanliness so that it can pay adequate attention to it.

(10) In the rear portion of the latrines, their number and ward number should be painted so that it may be possible to know the latrines which need improvement and inform the Municipality about them.

(11) If the latrines are in a compact area, each sweeper should be allowed to clean only 35 to 40 of them. They should not be allotted more.

Service Type of Public Latrines

It is difficult to keep public latrines clean, whatever their type. This is due mainly to the ways and habits of the Municipality, the sweeper and the people. They all need to be educated in this respect. Moreover, arrangements should be made for cleaning them thrice a day. In order to facilitate the working of sweepers, the following improvements are necessary :—

1. Provision of water near the public latrines is very necessary. In the absence of adequate arrangement for supply of water, it becomes difficult to clean them. It is easy to arrange it where water supply system is available. But where there is no water supply, some arrangement has to be made for the purpose. A small tank can be built near the latrine and supplied with water by bullock carts or fire-fighter units.
2. Enough pans should be provided to enable replacement of those which become full. If possible, tanker or bullock cart should be provided so that faeces may be transferred directly into it.
3. Arrangements should be made for adequate light and air in public latrines.

In addition, the improvements suggested in respect of private latrines should be made in these as well. One sweeper should be assigned two units of ten such latrines.

CHAPTER—XIII

GAS-PLANT

The problem of fuel is very acute in India. The old jungles are being cut at a rate far exceeding that of plantation of new trees due to which even the rainfall is decreasing. Where firewood is not available or is in short supply, cow-dung is being used. There is a cattle wealth of 20 crores in India. If manure is made out of their dung, the crop production would increase a great deal. Paradoxically, today there is shortage of manure on the one hand while on the other good manure is consumed in the shape of cakes as fuel. 40% of the dung is turned into fuel cakes, 30% is used as manure and 30% goes waste. With a view to getting fuel as well as good manure from cow-dung, several experiments for installing dung-gas-plants have been made in India. The gas from these gas-plants can be used as fuel and for lighting purposes and the residue cow-dung serves as good manure.

Dr. S.V. Desai initiated experiments on gas-plant in the Indian Agricultural Research Institute, Pusa, New Delhi. Before this, experiments on gas-plants had started in Germany. The Bhayara and Parekh Co. of Bombay had started the manufacture of "Gram-Lakshmi" gas-plants for agriculturists. The Khadi Commission has started its publicity throughout the country. There is also a scheme for grants and loans for gas-plants. The Khadi Boards in each state also have experts to provide technical guidance.

The gas-plant is more useful for the farmers who own five or six heads of cattle. They can get the necessary quantity of dung required for the preparation of gas. This solves the problem of fuel and lighting for one family. The initial outlay

in setting up a gas-plant is high but its cost is recovered in 5 to 6 years in the shape of manure and gas.

The gas plant is a very simple machinery. Its installation is also easy.

(1) A masonry well for the preparation of gas by the putrefaction of the mixture of cow-dung and water.

(2) An iron-tank for holding the gas (gas holder).

(3) Pipes for conveyance of gas, gas-ovens and gas lamps.

The gas used for lighting is called methane or marsh gas. It contains four parts of hydrogen and one of carbon. It is chemically represented as CH_4 .

The fuel problem of villages can be solved by gas. The gas burns without smoke and generates much heat. The oven is so made that the flame can be increased or decreased. The gas is odourless. This gas can be used for lighting also. Its light is cool and white as moonlight of the full-moon. Women find it very easy and comfortable for cooking purposes.

The cow-dung put in the gas plant automatically comes out after 30-40 days in the shape of manure which has enough manurial contents and nitrogen in plenty.

Materials that Produce Methane Gas

Any material which contains cellulose can produce methane gas. Materials which putrefy produce this gas e.g. grass, outer shells of groundnuts, husk of paddy, faeces, cow-dung, oilcake, dry leaves, waste, sewage, dirty water and all organic matters etc. Things which are easily available for daily use are useful for gas. Things which can flow out of the gas-plant automatically are useful. Where the putrefied products can be taken out with the help of machinery every material which can putrefy is used. The gas digester and gas-holder are constructed separately. But in village-gas-plants both the processes—preparation and collection of gas—can take place in the same chamber.

We regularly get faeces, cow-dung, urine in requisite quantity. Mixed with water, they can flow out automatically as effluent after putrefication. These are, therefore, more useful. Husk of paddy, dry leaves etc. putrefy and give out gases but do not easily get converted into flowing matter. They keep floating in the gas plant and do not easily come out of it. Therefore they are not used.

Essential Preliminaries

Before constructing a gas-plant we must first assess the quantity of the gas required for lighting and consumption as fuel and the size of the gas-plant. We should also find out whether the cowdung, faeces etc. for preparation of gas are available in plenty and how much space is available for the gas-plant in the kitchen or cow shed. If it is installed near the kitchen, it is more useful because the expenditure on gas-carrier pipes is less.

The Size of a Gas-Plant

We will now consider about the size of a gas-plant for a family. For a family of 5 to 7 persons, 100 to 125 cu. ft. of gas is required daily for fuel and lighting purposes. One head of cattle yields 20 lbs. of dung each pound of which produces $\frac{3}{4}$ cu. ft. of gas. Thus 15 pounds of gas can become available from the dung of one animal. It is more useful to attach the latrine also with the gas-plant. Faeces yields more gas than does dung. Fourteen ounces of faeces is obtained per head. On the basis of this estimate, sufficient gas is made available from the gas-plant for a family which has 5 to 6 heads of cattle.

Caste-iron stoves of various sizes are available for cooking purposes. The inner pipe of the stoves is circular and hollow. There are several holes on its top for the flow of gas. A stove is used for 4 to 5 hours every day for cooking. If a 6" diameter stove is used, it will consume 20 cu. ft. of gas. For lighting purposes, lamps of special kind are available. They are provided with mantles just like petromax gas-lamps. These

mantles are of 40 candle power. One such lamp consumes $2\frac{1}{2}$ cu. ft. of gas per hour. A lamp of two mantles requires $5\frac{1}{2}$ cu. ft. of gas in an hour. The size of the plant is fixed taking into consideration the dimensions of the stoves and the lamp, the time for which they are to be used and the quantity of dung and faeces available. The mixture used in the gas-plant produces the maximum amount of gas if it remains in the tank (digester) for 30 to 40 days. This fact is, therefore, taken into account for fixing the dimensions of the tank.

Types of gas-plant

Any organic mixture can be stored in the shape of fluid for putrefication and a drum shaped vessel placed over it for collection of gas. The gas thus produced will be inflammable. Taking these facts into consideration a simple gas plant should be devised so that even a farmer may be able to operate it with ease and may remove the defects himself.

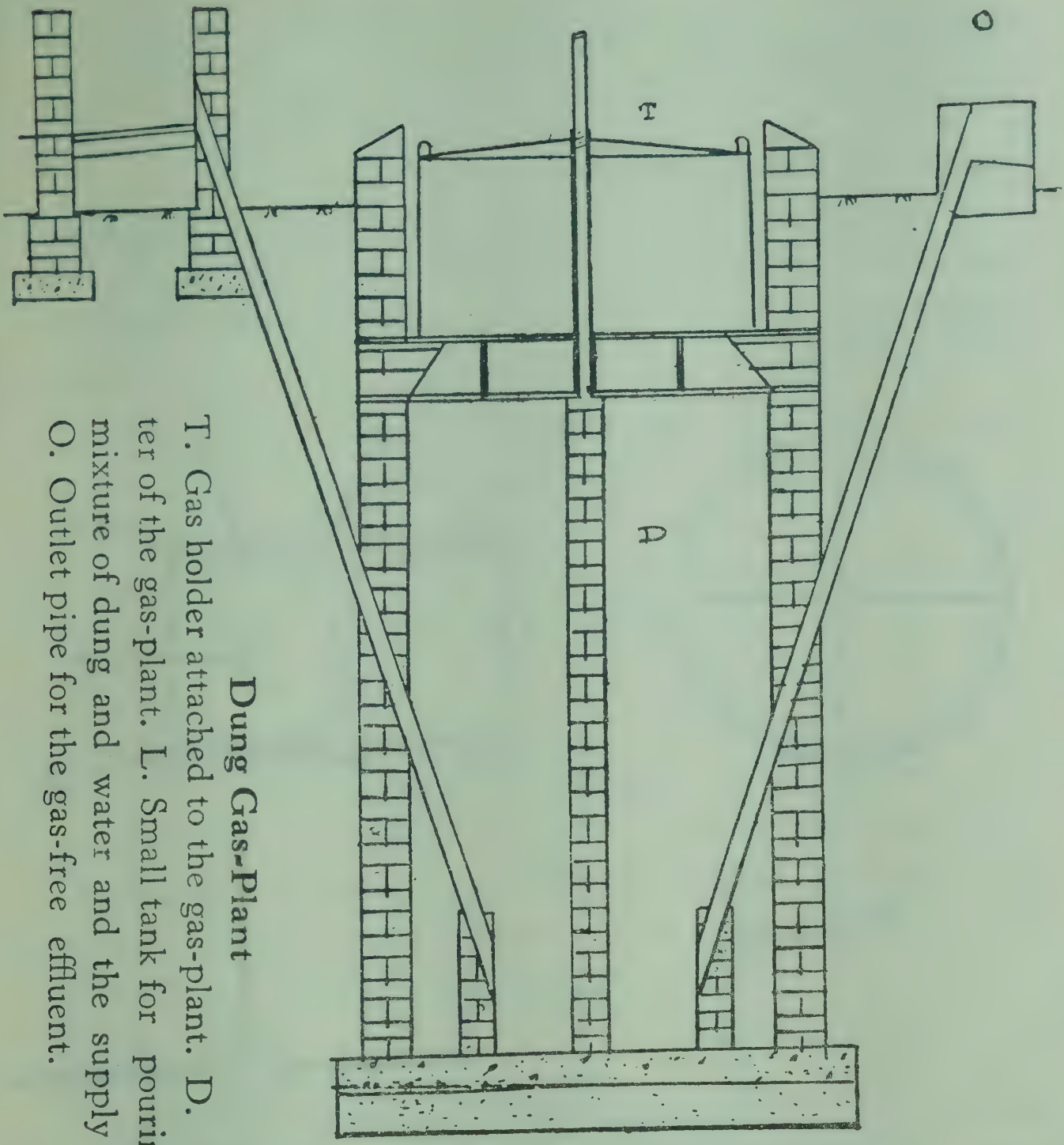
Where the soil is not hard, it is easy to dig a well. A deep well is dug for gas-plant where the water level is not high. This is called a simple gas-plant. It is simple and a gas tank is placed directly above the slurry.

Where the soil is rocky, a deep well cannot be dug. The gas-plant made at a place where water level is only 6 or 7 feet, is called a transverse gas-plant.

Where the gas-plant is connected directly to the latrines, dung etc. is not used. The gas-tank is not placed directly over the mixture but in a water-jacket to avoid filth and stench. This gas-plant is called water-jacket gas-plant.

In this gas-plant, the digester and the gas tank are installed in the same plant,

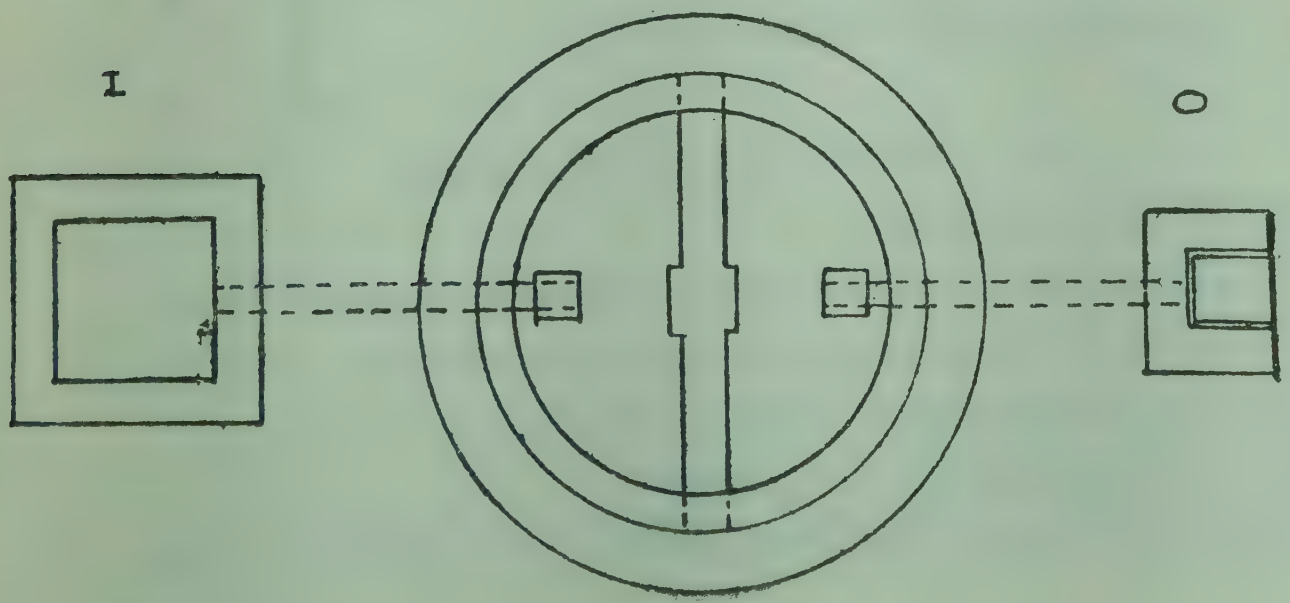
In bigger towns like Delhi and Bombay, the sewage is purified and the sludge and scum are removed. Big digesters are constructed on the ground with brick and cement and the gas is produced by churning this water mechanically. The gas-free sludge is used as manure. The gas produced is conveyed



Dung Gas-Plant

T. Gas holder attached to the gas-plant. D. Digester of the gas-plant. L. Small tank for pouring the mixture of dung and water and the supply tube. O. Outlet pipe for the gas-free effluent.

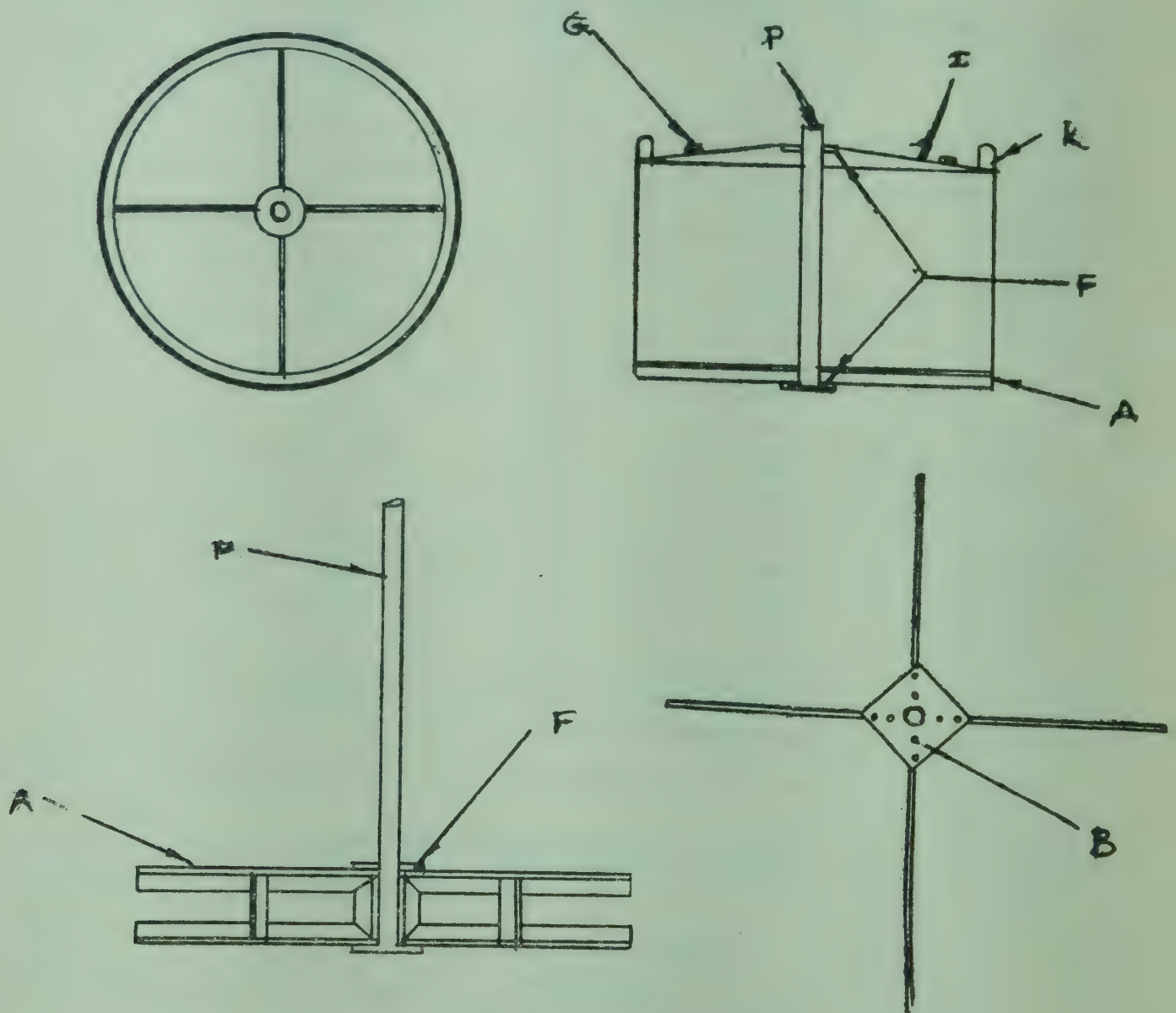
SECTION ELEVATION



by pipes to be stored in the gas-holder and given out for use. All these processes are done by machines. In comparison, the dung and faeces gas-plants are very simple.

Construction of gas-plant

A well 16' deep and having a diameter of 9' should be dug. Its bottom should be strengthened with gravel in a cement mixture of 1:4:8 which should be hammered down to make it 9" thick.



Gas-tank and its control

- A—Angle-iron frame.
- B—Iron-plate, fixed with the frame with nuts and bolts.
- C—Hole for releasing gas from the gas-holder.
- F—Iron-plates on both sides of the tank.
- K—Iron-handles around the tank.
- P—Control pipes fixed between the tank and the frame.

Keeping the inner diameter as 5 feet, a 14" thick circular wall should be built with 1:8 cement mortar. In order to divide the tank into two a 4½" thick and 13' high wall should be built. A cement pipe of 4" diameter should be fixed for the effluent at a height of 1¾' in one half of the tank. This should be 9" above the upper surface. In the other half also a cement pipe of 4" diameter should be attached at a height of 1¾" from the bottom. This should be 3" higher than the upper surface. At the ground level both the pipes should be at a distance of 2 feet from the wall of the tank, so that the requisite slope may be provided. After reaching a height of 11½' in the construction of the tank, the two upper rows of bricks should be projected 3" inside the tank. The diameter of the well will thus be 4'—6". The portion above these two rows should be built upto a height of 3'—3" with a diameter of 5'—6". The tank should be plastered from inside and its upper surface should have a gradient towards the outer side. The transverse wall in the middle should be 12' high. The bottom should be made 3" thick with cement concrete in the ratio of 1:2:4 and plastered with cement.

Gas tank controller

When the height of the tank reaches 11'—6", a controller is installed to control its vertical and horizontal movement.

A frame of iron-angle 1½" × 1½" is erected in the form of a ladder and 1" × 1" piece of 12 guage iron-sheet is fixed in between by nuts and bolts. In the centre of this plate a coupling of 2" diameter is welded. The rectangular iron-angle-frame is so fixed in the wall that the coupling is in the centre. A 3' long galvanised pipe of 3" diameter is attached to the coupling to control the vertical movement of the tank.

There are three or four ways of controlling the vertical movement of the tank. But this has been found to be the most useful.

If scum collects on the surface it can be broken by rotating the tank as it is not possible to break the well. As the gas accumulates in it the tank rises and as the gas is expended the tank goes down.

Pit for dung

A pit $1\frac{1}{2}' \times 2'$ be constructed along the pipe which is fixed 9" from the surface, for pouring the dung-mixture. Its gradient should be in the opposite direction to that of the pipe so that the earth etc. may remain at the bottom. A net should be fixed near the mouth of the pipe to prevent escape of the floating matter like grass etc. The pit should be 9" deep. It should be cemented. The pipe through which the mixture flows to the tank is called the supply pipe. In front of the net at the mouth of the pipe an arrangement for closing it with a tin or wooden flap should be made so that the dung and water can be mixed in the pit when required.

Iron tank for gas

A circular tank of 5' diameter and 3' height should be made of 14 or 12 gauge M.S. sheet. The lower part of the tank should be kept open and the upper closed by iron sheet. The centre of the upper part should have a 6" rise and be conical in shape. At a distance of 1' from the centre a 1" hole should be made and the coupling joined with it. A one-inch sluice valve should be fixed in it. Inside the tank a ring made of $\frac{3}{4}" \times \frac{3}{4}"$ angle-iron should be joined to the lower end of the upper part. A hole of 3" should be made in the top centre of the conical piece. A 3" pipe of the height of the tank should be joined inside it. To keep it fixed in the central position four pieces of angle-iron should be joined to it at equal distances from the four sides. The entire tank should be welded. The tank should be so placed that the pipe fixed

in it should be just above the control pipe of the gas-plant-well so as to enable the tank to have a smooth upward and downward movement.

Gas pipe, stove and lamp

A galvanised pipe 1' in length should be fixed to the sluice valve and connected with a 6' long rubber hosepipe. From the gas plant to the kitchen, 1" or $\frac{3}{4}$ " galvanised pipe should be laid inside the ground. It should have a gradient towards the gas plant. A polythene pipe can be used instead of the galvanized pipe. The pipe should be connected with the stove with a plastic pipe. A cock be fixed in the stove to stop the flow of the gas. The cock should be closed when the gas is not required. The rubber pipe attached to the tank should be connected to the underground pipe. It does not give trouble when the tank moves up and down. By providing a gradient in the pipe, the moisture that enters with the gas, turns into water and collects at the place where a cock is placed. Periodically the cock is opened and water allowed to flow out. If moisture goes in with the gas, the stove does not work properly. When water is taken out, it gives a good flame. Pipe is fitted upto the place where lighting is required. Specially constructed gas lamps are available for this purpose.

Precautions before starting the gas plant

The well of the gas plant should be made strong by plaster.

Both parts of the well should be simultaneously filled with a mixture of dung and water in equal proportion. Thus the entire tank is first filled with the dung mixture.

After that the gas-tank is placed over it. This tank will rest at the 3" projection of bricks and will thus remain dipped in the dung-mixturer.

The gas tank will automatically start rising after 10 to 15 days. This gas should be allowed to escape by opening the cock. The gas produced subsequently should be used as fuel.

If the production of gas stops then add one or two cans of mixture from the other gas plant or septic tank. The bacteria will, thereby, start the production of gas.

Preparation of Methane Gas

The effluent lying for 30-40 days in the digester starts putrefying and the gas produced goes on accumulating in the tank. The quantity of gas will depend on the quantity of the mixture of dung and faeces put in the digester every day. The gas-free effluent comes out of the other pipe fitted below the supply pipe, in the form of ready manure.

The quantity of water in the dung mixture should be in a fixed proportion. If it is more, then less gas will be formed. If the water is less, the effluent will not come out easily.

Suitable temperature is necessary for the production of gas. Gas is produced at 80°F. The gas-plants yield less quantity of gas in cold regions. They are more useful in hot regions. One pound of dung yields $1\frac{1}{2}$ Cu. Ft. of gas at 50° F. whereas at 80° F, it is 1 to $1\frac{1}{2}$ Cu. Ft. The period for which the effluent is kept in the digester is also important.

This gas easily catches fire by exposure to air. It does not catch fire if its proportion in air is less than 16%. Therefore, if the gas escapes from the tank when not in use, it entails no danger.

The dung mixture contains other gases also but the greater part of it is Methane.

	<i>Gas from dung</i>	<i>Gas from faeces</i>
1. Methane (CH_4)	50 to 55%	60 to 65%
2. Carbondioxide (CO_2)	40 to 45%	30 to 32%
3. Nitrogen (N_2)	2 to 5%	2 to 5%
4. Hydrogen (H_2)	1 to 2%	0.5 to 1%
5. Oxygen (O_2)	0.1 to 0.4%	0.1 to 0.4%

The heat from Methane is $1\frac{1}{2}$ times more than from other gases. It is 400-500 British Thermal Units from dung-gas, 600-650 B.Th.U. from faeces-gas and 500 to 550 B.Th.U. from the gas out of a mixture of dung and faeces.

Methane being lighter than air, it flows onwards in the pipe. It does not ignite inside the pipe because of the absence of air. The specific density of Methane is 0.55. The gas which is colourless gives a blue flame on ignition but no odour.

Alkalinity and acidity are also essential for the production of gas from the mixture. If they are not in proper proportion the production of gas stops. P.H. value should be between 7.1. and 7.6. If alkalinity increases, the output of gas decreases. If the P.H. value reaches 8.9, the production stops. If acidity and alkalinity is balanced, its value is taken to be 7. If it is less than 7, then it is called acidic, if more than 7, then alkaline.

It is often necessary to apply pressure on the tank for using the gas. To test whether the pressure for ignition of gas is suitable or not, the stove is immersed 1" to 2" inside water in a vessel and pressed. If the gas continues to come out when the stove is pressed 1" to 4" under water then its pressure is suitable. Gas-pressure-gauges are also available, but they are not needed in homes.

Manure from gas-plant

The manure comes out in the form of effluent, in 30 to 40 days. Two pits should be dug nearby and these should be connected through a drain with the outlet pipe. The manure can be drained into these pits or taken directly to the field. It is odourless and free from germs and flies and mosquitoes etc., do not breed in it. The useless grass also gets purified after putrefication.

The contents of this gas-free manure are as under :—

	<i>from dung</i>	<i>from faeces</i>
Nitrogen	2.23%	7.40%
Phosphorus	1.29%	2.4 %
Potash	1.47%	2.7%

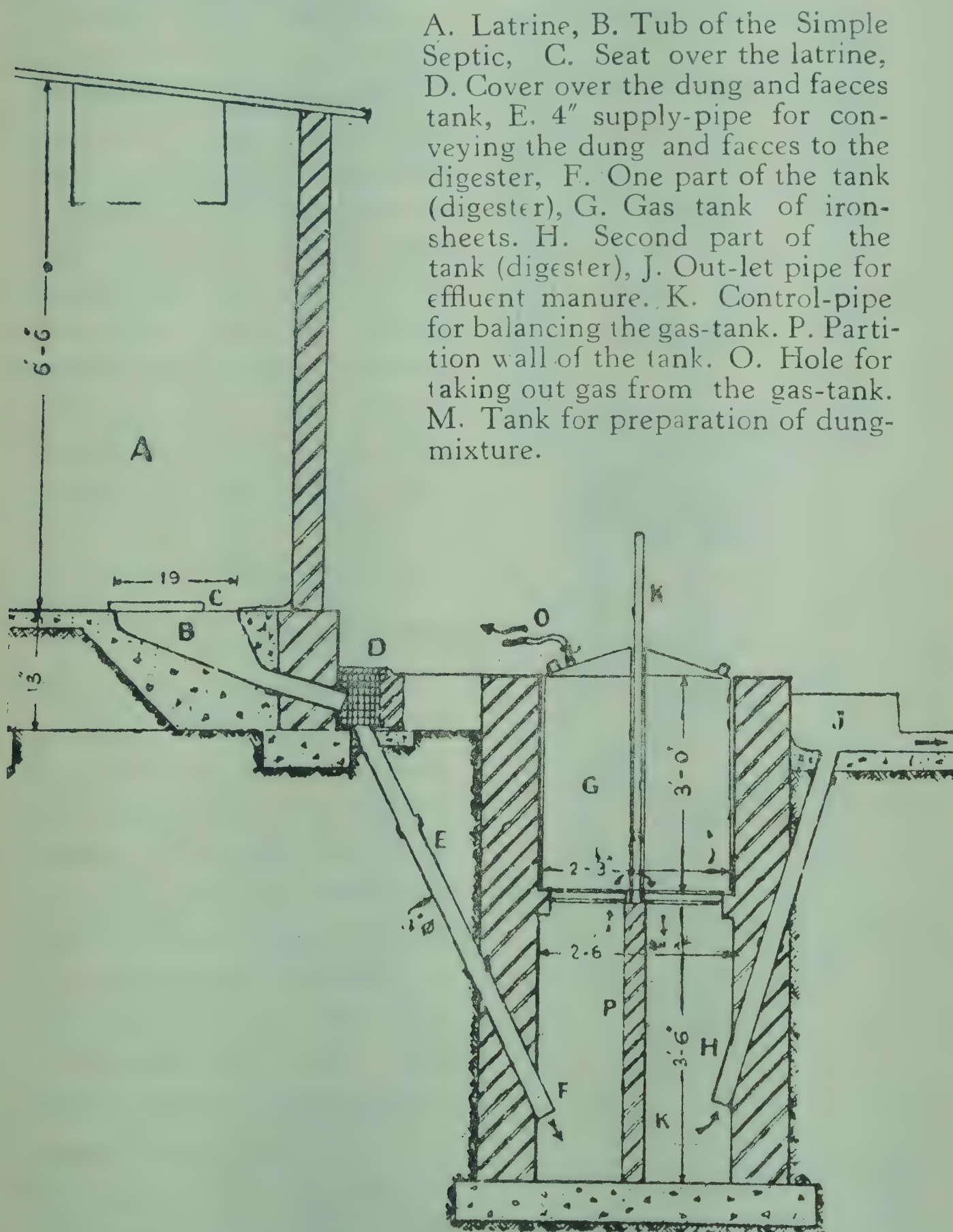
Thus the gas-plant produces a good quality manure as well as gas. It is a small factory in the farmers house for scientific production of manure on a small scale.

Necessary information

1. A mixture of dung and water in equal proportions should be regularly added to the gas plant. Earth and other refuse should not get in.
2. The gas-tank should be periodically painted with paint or coal-tar.
3. The water accumulated in the syphon of the gas-plant should be periodically removed.
4. The holes in the stove should be kept clean so that the passage of the gas is not obstructed.
5. This gas can be used for ironing, engine, refrigerator, stove and lighting etc. This cannot be taken about filled in cylinders like burshane gas. It cannot be liquified.
6. If the latrine is attached to the gas plant, it will become a clean and service-free latrine.

Latrine-cum-gas plant for family

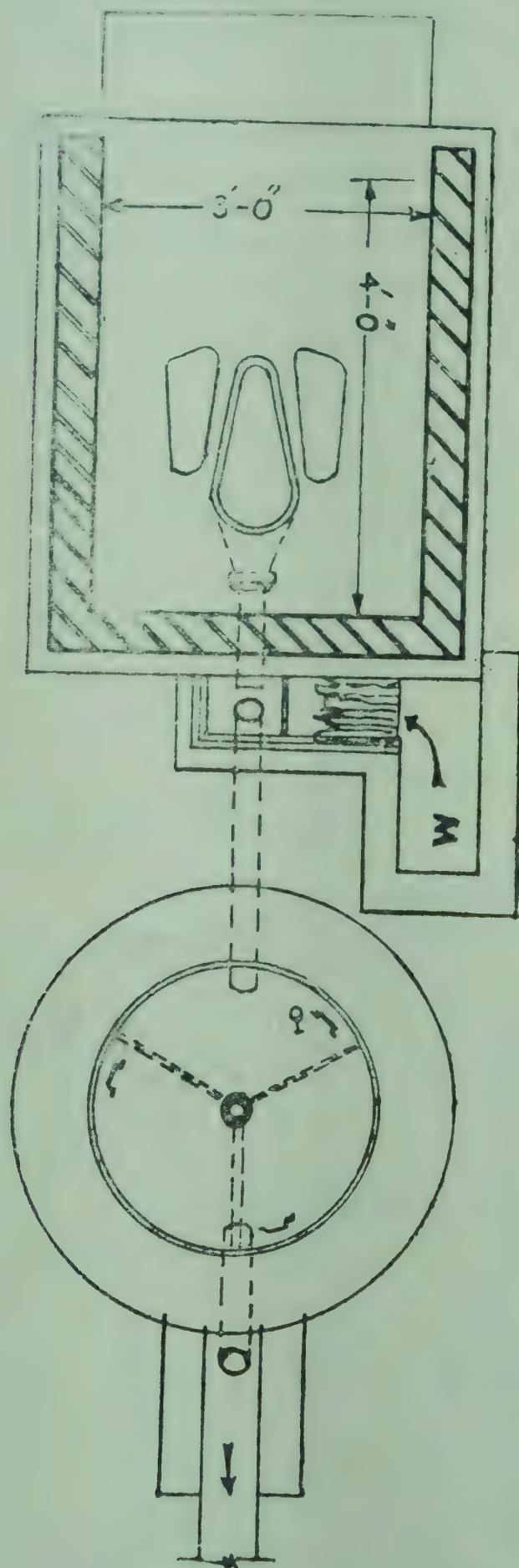
A latrine-cum-gas plant can be built for a family. It will be cheaper than a septic tank and will turn faeces into manure. The latrine will be neat and clean. It should have a 3 ft. high tank of 27" diameter.



Latrine-cum-gas plant

Dig a 6' deep well with a 30" diameter. It should be built with bricks or stone. A small gas plant will cost

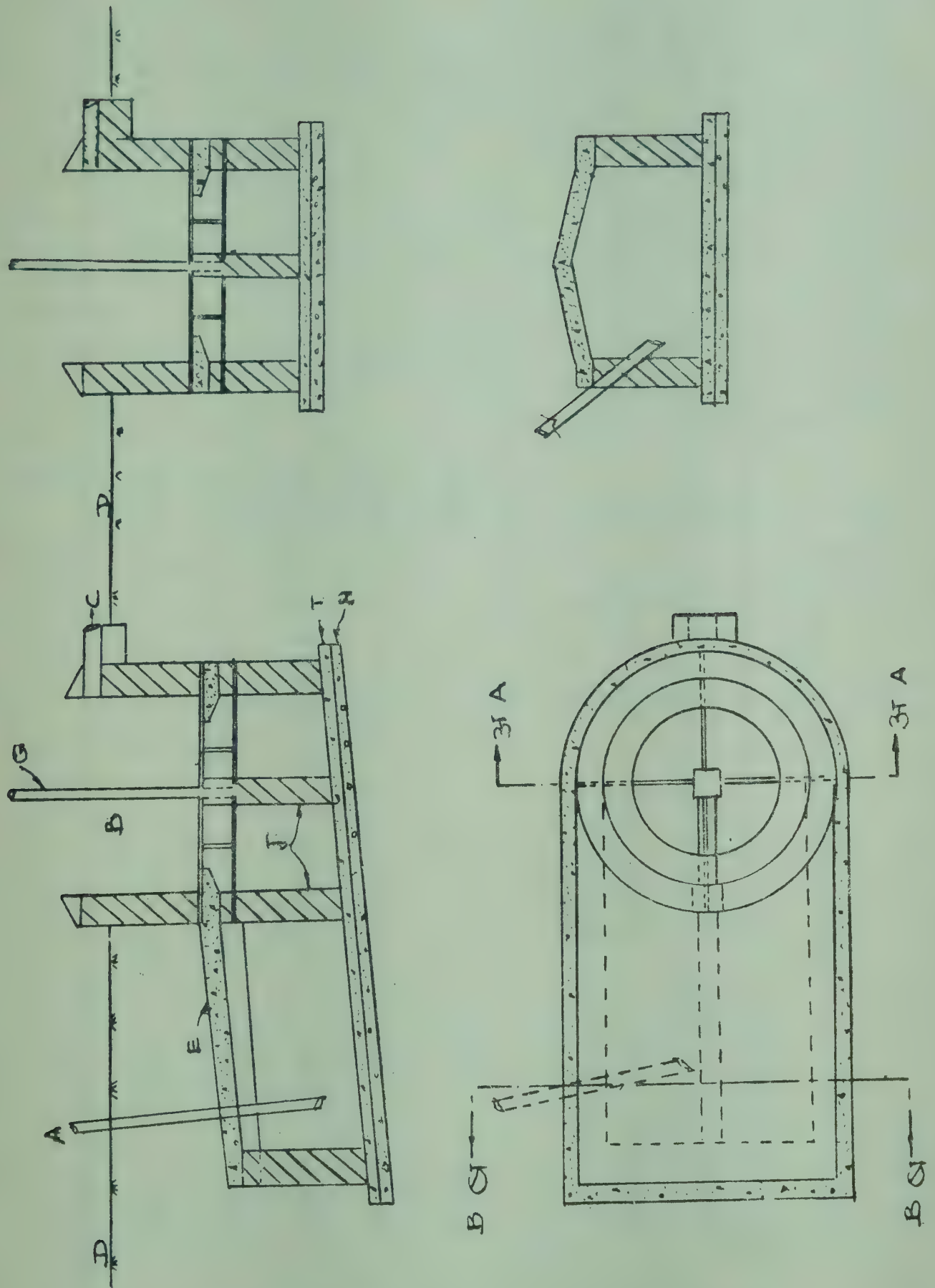
Rs. 250-300. It will produce 8 cu. ft. of gas which will be sufficient for 3 hours of lighting or $\frac{3}{4}$ to 1 hour of cooking. If a little dung is added, more gas will become available. The gas-plant can be built in a 7' \times 4' space. The latrine should be fitted with the tub of the Simple Septic. If water is used in greater quantity, gas produced will be less. The gas-free effluent is odourless which when dried turns into powder. It does not have germs nor breeds flies and mosquitoes.



flow out by pouring water. of 1" per foot.

Public-latrine-cum-gas plant

By attaching a set of 12 latrines, a gas-plant of 6 ft. diameter may be built. A smaller gas-plant can also be built according to the number of latrines. If two rows of latrines are built with a drain in between, the faeces in drain will go into the supply-pipe. The drain should be kept covered. There should be an arrangement at its end for cleaning. The faeces will



Detailed plan of transverse gas-plant

A. Supply-pipe for dung-mixture, B. Portion to place gas-holder, C. Outlet for effluent manure, D. Ground level. E. R.C.C. slab, over the transverse-gas-plant, G. Control pipe for balancing the tank, J. Partition wall of the well.

Material used in a gas-plant

Serial	No. of	Dung in	gas in	Dimentions	Dimensions	Bricks	Cement	Sand	Dimensions
Number	cattle	pounds	cu. ft.	of the tank	of the well		in bags	in bags	of the tank
				(diameter)					(diamter)
1.	4	80	60	8' × 12'	4½' × 13'	4000	22	3	4' × 3'
2.	5	120	90	6' × 12'	5½' × 13'	4500	25	4	5' × 3'
3.	8	160	120	9½' × 13'	6' × 14'	5000	28	4	5½' × 3'
4.	10	200	150	10' × 13'	6½' × 14'	5500	30	5	6' × 3'
5.	12	230	180	10½' × 13'	7' × 14'	6000	32	5½	6½' × 3'

Construct a latrine for 20 persons. If 25 persons use it then 100 to 125 cu. ft. of gas will be produced which will be sufficient for lighting and cooking purposes of a family. Add some dung in the gas plant so that scum may not accumulate and the effluent may automatically flow out. The tank should be rotated periodically to break the scum. The gas plant should be built like the dung-gas plant. Simple Septic tubs in these latrines have proved more useful. By the construction of a waterseal latrine more water is used and therefore less gas is formed. If a water seal is to be had, then the trap should be such which needs less water. The latrines should be cleaned twice or thrice a day. Arrangement for water should be made for this purpose.

The gas-plant-well should be prepared in accordance with the above measurements. Its cost varies according to the local price. For a family the gas-plant costs Rs. 1200 to 1500.

A transverse gas-plant is constructed where a deep well cannot be dug.

CHAPTER XIV

URINAL

Latrines and bathrooms are now being constructed in newly built houses, but no consideration is given for the provision of a urinal. In the cities, the flush type neat and clean latrines also serve the purpose of urinals. Where the latrines are of service type, very little use is made of them as urinals. Mostly the bathrooms are used for this purpose. As, however, no water is poured over it, the bathroom stinks and sometimes it becomes difficult to take bath in it. Two footrests can be provided in a part of the bathroom and used for urination. But they need a great deal of attention for cleanliness.

The number of urinals in public places, markets and on roads is inadequate. People make all the more nuisance at places where it is written, 'do not commit nuisance'.

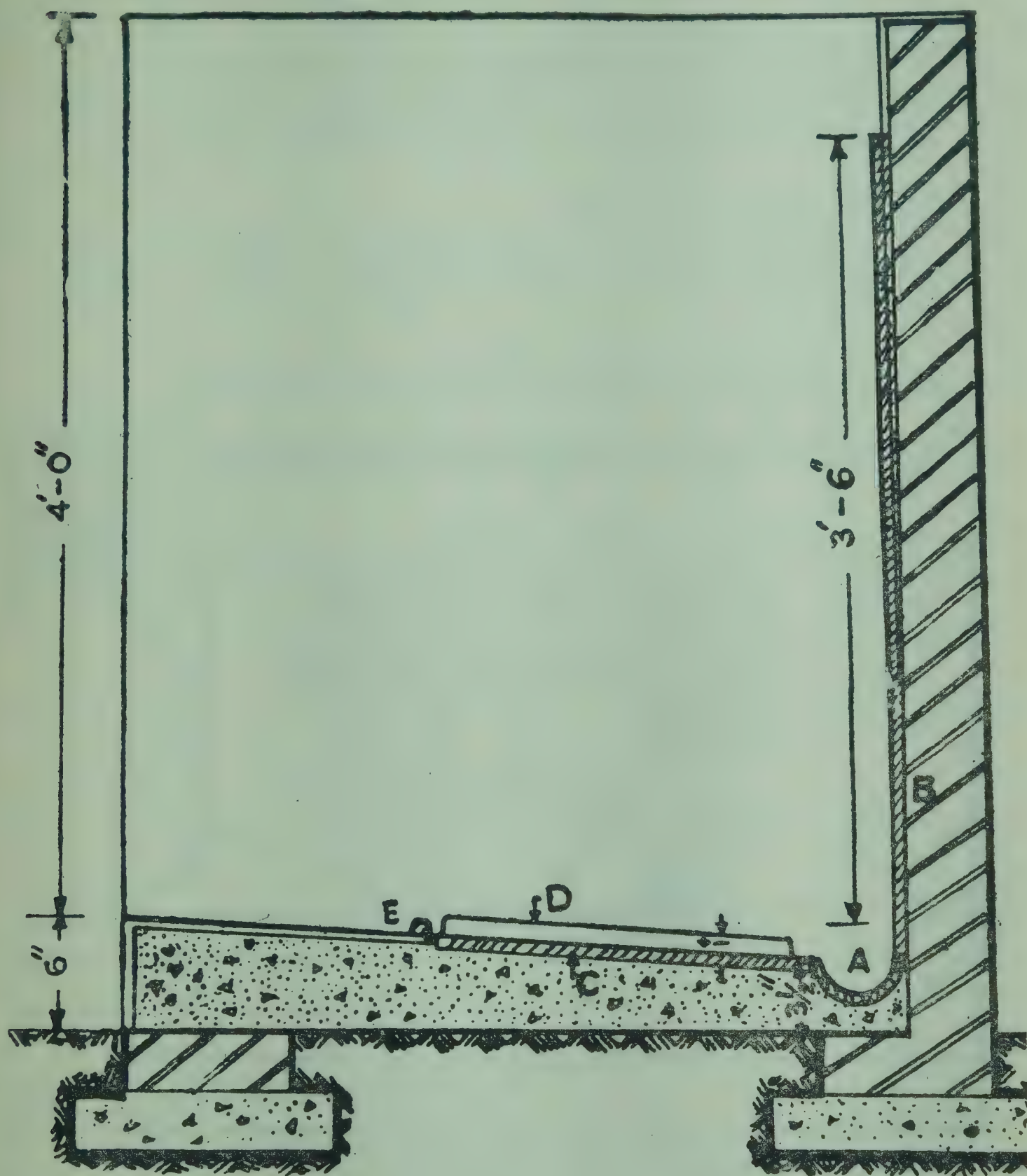
Urinals are made at various places. At crowded places, two or three urinals are put up together but their surroundings remain filthy. Provision for water tank for them is made over the roofs and the screening walls in the rear. Sometimes they are entirely lined with white tiles. Despite all this, owing to the lack of vigilance of the municipalities and the habits of people, these places turn into a hell. The water flush does not work and the screening wall only facilitates people in using it as a latrine at night.

Where the sweepers keep constant vigilance and sufficient water is provided, the urinals remain neat and clean.

Urinal Site

Too many urinals should not be built at one place. But one or two of them should be provided at the end of every

lane. Provision of water should be made. It should be compulsory to clean them twice or thrice a day.



Urinal

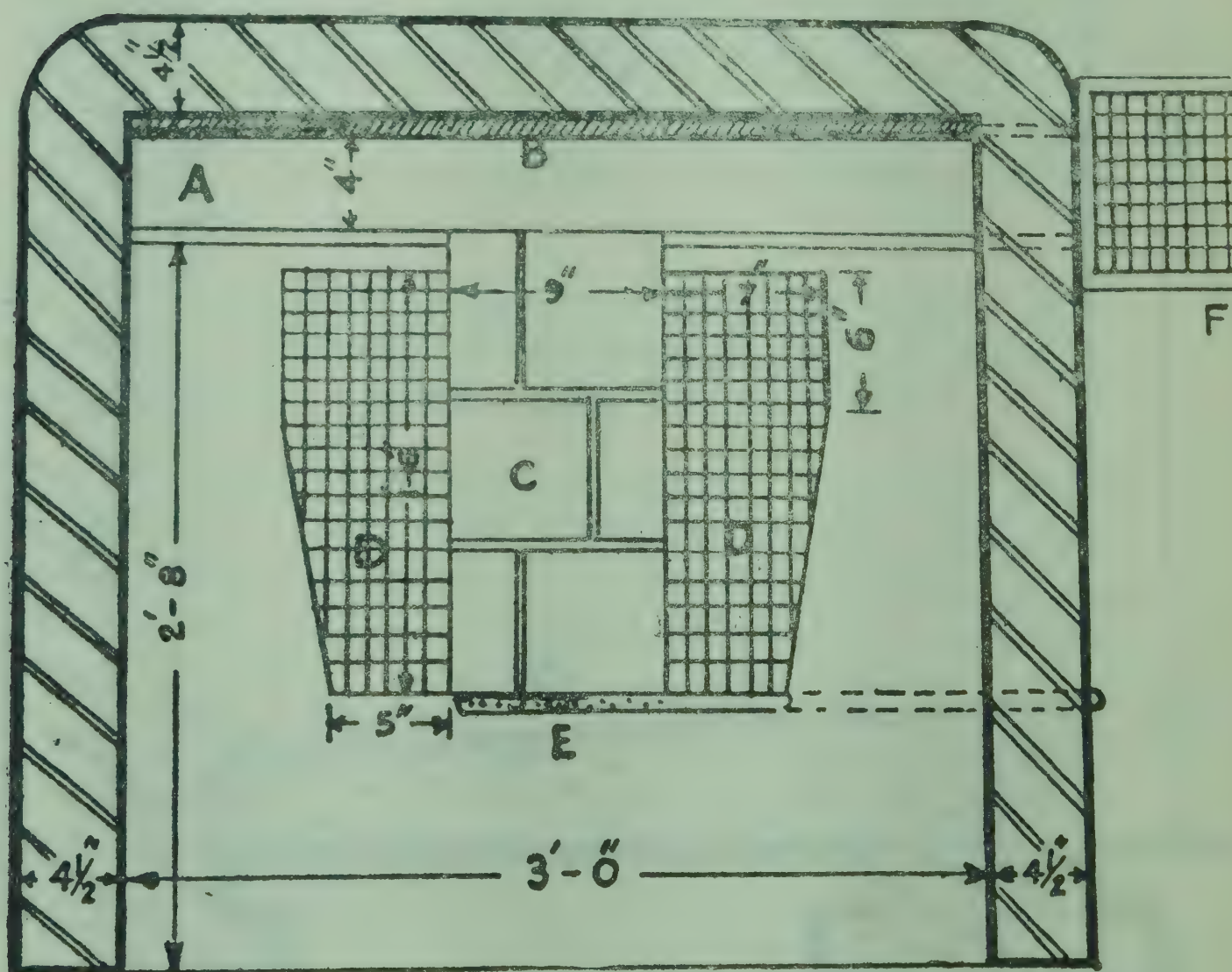
A. 3" deep 4" semicircular china clay pipe. B. Tiles on the front wall. C. China-clay tiles between the foot-rests. D. Two inches high foot-rests. E. Flushing pipe with holes. F. Soakage pit attached with gully-trap for urine.

Urinals with doors should also be provided for women at suitable places.

At many places, urinals are built over open drains. In such cases, the problem of cleaning them often does not arise nor is expenditure incurred on soakage pits or cesspools. They should be provided at the rate of one for 300 persons.

Construction of a urinal

The inside dimensions of a urinal should be $2\frac{3}{4}' \times 3'$. The platform should be raised at least 6". It should have a gradient of 1" in a foot.



Urinal

It is not necessary to provide tiles throughout the urinal. It is enough to provide tiles upto the height of $3\frac{1}{2}'$ on the front wall and 1' on the side walls of the platform. Tiles should also be provided between the foot-rests. There should be a space of 9" between the two foot-rests which should be

1½ ft. long, 7 inches broad and 2 inches high. In between the foot-rests and 2" lower a "V" shaped space 2" deep can also be provided for the flow of urine.

A "U" shaped pipe of 4" diameter should be fitted inside the urinal. A ready-made half-pipe of china clay or stoneware should be used. A slope of ½" per foot should be provided.

Only three walls each of 4½" thickness and 4' height should be built for the urinal. There should be no screening wall in the rear as this leads to its use being made as a latrine.

There should not be more than two urinals at one place. Many of them may, however, be made at a short distance from each other.

There is no need to provide an overhead water tank for flushing the urinal. If facility for water exists then, instead of the automatic flushing system, a pushcock should be provided in the front wall with the necessary information for its use. The automatic arrangement should be made where the rush is great. The water supply should be abundant. Towns which have no water-supply should make arrangement for cleaning the urinals two or three times a day.

The walls of the urinal need not be very high. Urinals for women if constructed near houses should have roofs but otherwise there is no need to incur expenditure on roofs. Air and sunshine will be conducive to cleanliness and less stench. Urinals with pans may also be built for urinating while standing.

Provision of Urinals for Women

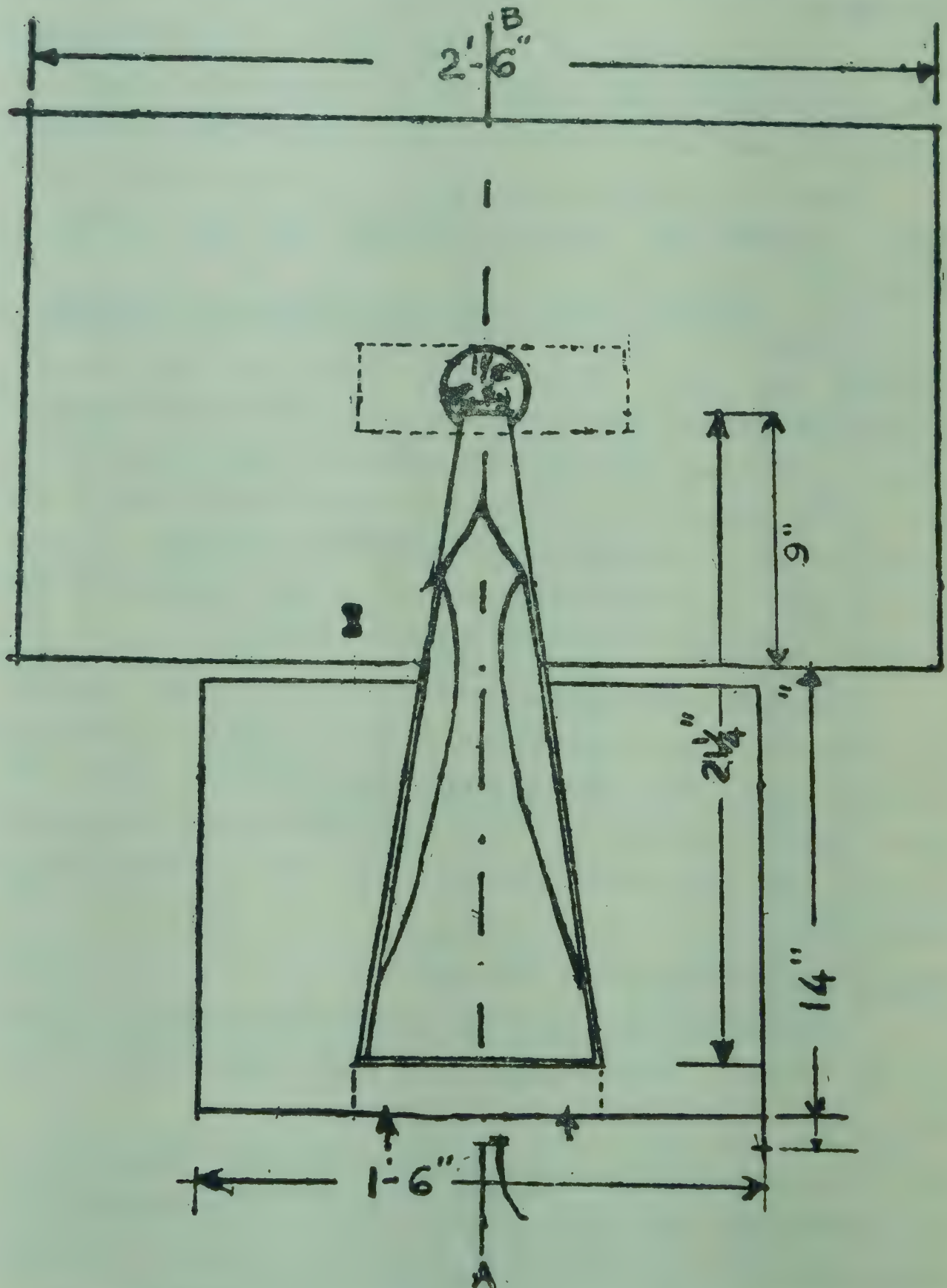
There should be urinals for women also in public places in the cities. These would be slightly different from those for men.

The walls of this urinal should be 5' high. There should be a screening wall also. These should be provided with 4 ft. doors at a height of 6" from the platform. Provision should be made for automatic or push-cock flushing.

There should be a small platform with a water tap outside the urinal. This will make it easy to keep the urinal clean.

Stench free (manure producing) urinal

We have considered the provision of urinals in towns. Let us now consider how to make urinals in the open space



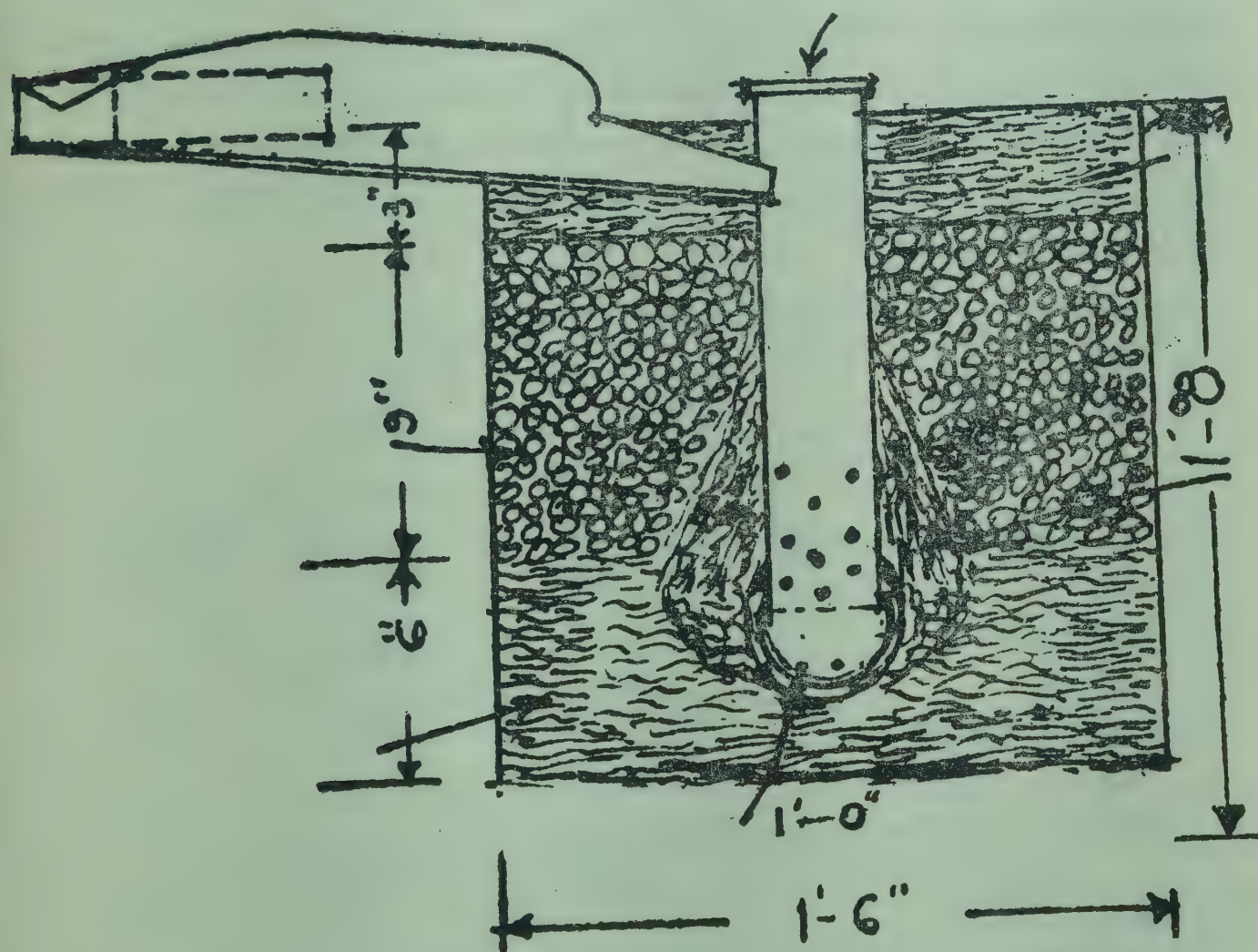
Plan of a (kachcha) stench-free urinal with pit and pan

near one's house in a village. For a family, the urinal may be Kachcha. It can be constructed by oneself from locally available material.

The manure from urine contains more nitrogen and is therefore known as "golden manure".

Construction of stench-free urinal and material used

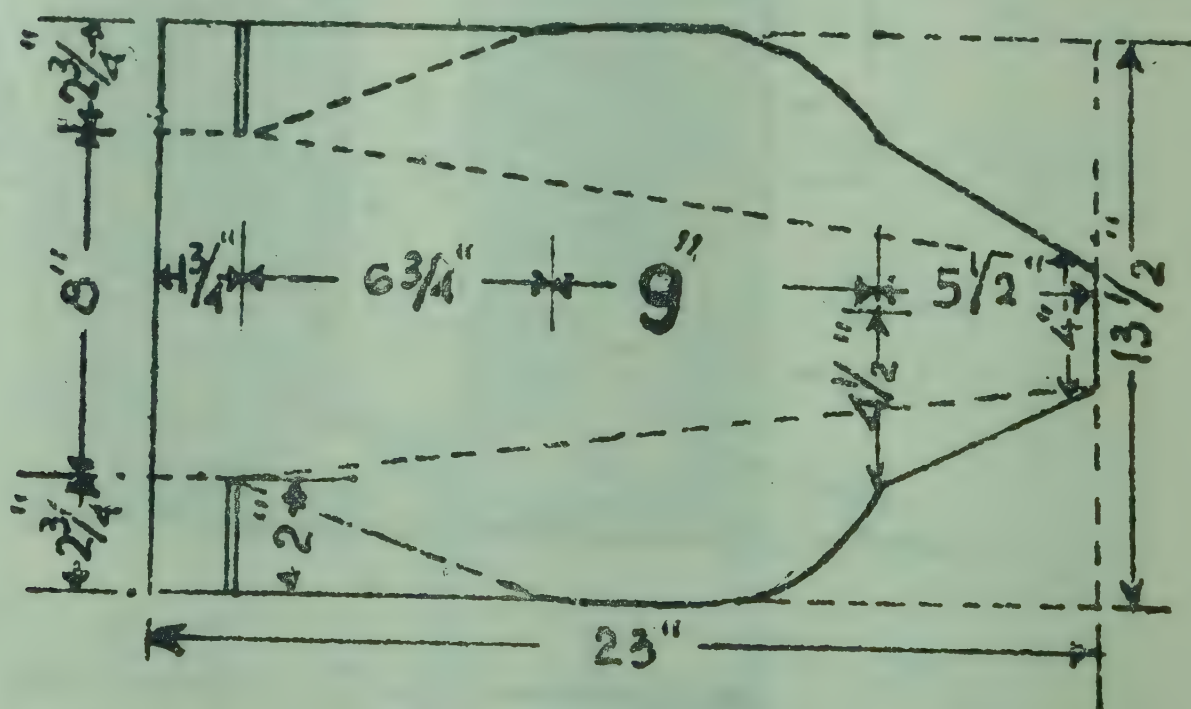
Dig a pit $2\frac{1}{2}' \times 1\frac{1}{2}' \times 1\frac{1}{2}'$ and coat it with dung. For manure, useless waste like chaf, leaves and grass, dry dung or cakes, ashes, paddy husk etc. are used in the pit. By doing this not only waste material is put to use but manure is also obtained. The available material should be placed in the pit in layers e.g. first a 6" layer of grass and then a 6" layer



Pit of the urinal showing the manner of placing waste matter of dry dung and over it another 6" layer of dry leaves and so on with layers of other putrifiable articles. The last layer should be of dry leaves in the pit. A $1\frac{1}{2}$ ft. long bamboo pole

with $1\frac{1}{2}$ " hollow inside should be placed in the centre of the pit over the 6" layer of grass leaves etc. The upper end of the pole should be closed and, at a distance of 1" from the top, a hole $1" \times 1"$ should be made in it to which the urine pan should be connected. Five or six holes should be made in the lower part upto a height of 1' so that the urine may seep into the grass, leaves etc.

The lower end of this pipe should be attached to a 9" long hollow bamboo piece having holes in it. It would look like the reversed 'T' (\perp). It should be wrapped around with grass and leaves etc. The upper end of the pipe will be $2"$ to $2\frac{1}{2}"$ above the ground level. A rectangular wall of brick should be made around the top of the pit. At the place where a hole has been provided in the bamboo pole an empty kerosene oil can cut open should be joined as a urine pan as shown in the diagram. The pan should be 8" broad with a 1" diameter tube in front. As the pan has raised ends on both sides, urine will not spill over.



Measurements for making urine pan from iron-sheet

The urine pan should be joined to the bamboo tube as shown in the diagram. The pan and the tube should have a slope. If the pan is painted or coated with coaltar it will not rust. On both sides of the pan footrests should be provided.

Technique of preparing manure from urine

When an organic matter lies open to air a state is reached where it starts to putrefy and aerobic bacteria start the process of the production of manure. They derive their food from the organic matter and produce manure as a by-product.

It should be so arranged that aerobic bacteria multiply in the pit. The bacteria multiply if put in contact with earth upto 3'. They need food for multiplication which is derived from the urine. They need a suitable medium also which is provided by waste matter.

Grass and leaves, waste matter, paddy husk etc., are a kind of absorbent. If put under microscope they will show fine porous tubercles. Being porous, these tubercles absorb urine. When these small tubercles come in contact with urine, it starts rising slowly in them owing to capillary action.

In the same way the urine which goes down the pit through the bamboo tube will gradually rise up to the brim of the pit. When this condition obtains the pit should be considered to be saturated with urine and should not be used thereafter. The bamboo tube and urine pan should then be removed from the saturated pit and the latter closed with earth. In a month and a half or two months, the manure will be ready. Meanwhile, another pit should be used. The urine rises easily only upto $2\frac{1}{2}$ ft, by capillary action. Therefore, the pit should not be deeper than this.

How can urinal be stench-free

When urine falls on the ground it begins to stink immediately. In the urinal, where the urine is allowed to spread over grass-leaves etc, the Ammonia (H_2S) produced from it is absorbed in their pores. When the urine accumulates it begins to putrefy. The urine contains protein, nitrogen, and salts. To remove the stench, lime water should be sprinkled in the urinal. The lime converts the ammonina into ammonium salts which do not give out stench. Where manure is produced

D.D.T. or phenyle should not be used. They kill the manure producing aerobic bacteria.

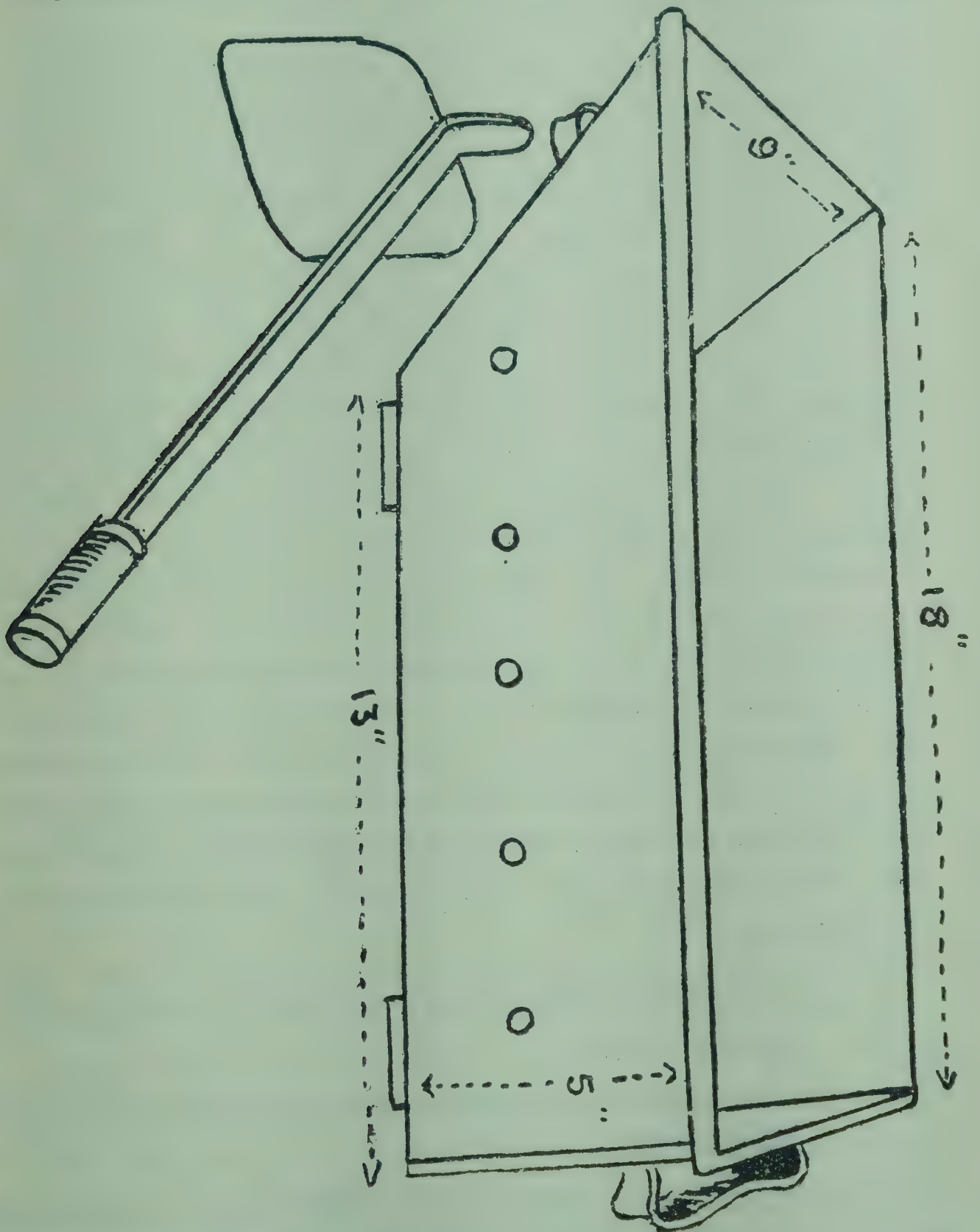
Public urinals with manure

By constructing two pucca pits of $3\frac{1}{2}' \times 3' \times 3'$ and filling them with garbage etc., they can be alternately used as urinals in schools, boarding houses, and village-Panchayats and manure can be produced. The pits should be kept covered. The urine should be let off in the pit through cement pipes. This will make them free from stench.

Manure from urine contains more of nitrogen and it should, therefore, be mixed with other manure before using it in the fields. If the manure is not to be used immediately, then it should be stored in pits and covered with mud.

CHAPTER XV FAECES PAN

Conversion of service latrines into sanitary ones is very essential, but so long as they continue to be in existence, improvements must be made in them.



Pot and Scraper

Generally, pots are not placed in latrines. Instead, broken canisters, unserviceable brass pots, broken buckets, earthen pots or bamboo baskets are kept. Even these receptacles are not properly kept. Faeces keep sticking to them. The baskets get rotten and useless. It is very difficult for the sweeper to keep these equipment clean.

At many places, even such pots are not kept. Such latrines are like hell. The faeces fall directly on the floor. The floor is half kachcha and half pucca. Faeces dissolved in urine and water flow in the open gutter. At places heaps of faeces lie which is difficult to clean. At some places ash, earth, grass etc. are thrown over faeces. This causes great trouble in carrying the faeces. It does not easily come out of the tanker and has to be washed out of it. Many times the valves of the tanker get jammed. In such circumstances the faeces have to be carried in trailers under sub-human conditions. It is rather easier for the sweepers to clean the service latrines having no pots as the quantity of faeces is less since part of it is washed away. The urine flows out with water and has not to be removed. People do not give water for washing the pots. For these reasons the sweepers, at many places, do not like the pots to be placed. But from the point of cleanliness and health it is necessary to have the pot. Keeping these points in view a simple design of the pot has been prepared. Such pots are kept at some places by the railways, but they, too, need improvement. The following points are necessary for a faeces-pot :—

1. It should not be so heavy or large as to cause trouble to the sweeper.
2. Its construction should be such that it can be cleaned easily.
3. Urine and water should flow out of it into gutters or soakage pits so that the sweeper may not have to carry them.
4. The pot should be cheap and durable.

5. The pot should have handles on both sides so that the sweeper may hold it or take it out easily if it is far inside.

For a family, the pot for faeces should be 18" long, 9" broad and 5" high. There should be a slope of 5" on one side of it so that faeces can be slid easily into the bucket. The upper edge of the pot should be strengthened with a $\frac{1}{8}$ " thick wire which would also prevent it from bending. If the pot is constructed of a 24-gauge galvanised tin, then it will last for six to eight months. It should be made of black sheet. The pots should be coated with dry coaltar every two months otherwise they would get ruined from the acid in the urine. Dry coaltar prevents it from rotting. The pot costs only five to six rupees. The municipality should charge the cost of the pots along with the latrine-tax and arrange for providing them in the latrines. This would not only bring uniformity but would also make cleaning latrines easy. If the municipality is unable to shoulder this responsibility then it should arrange to get them prepared and sell on payment. The house-owners will greatly benefit from it.

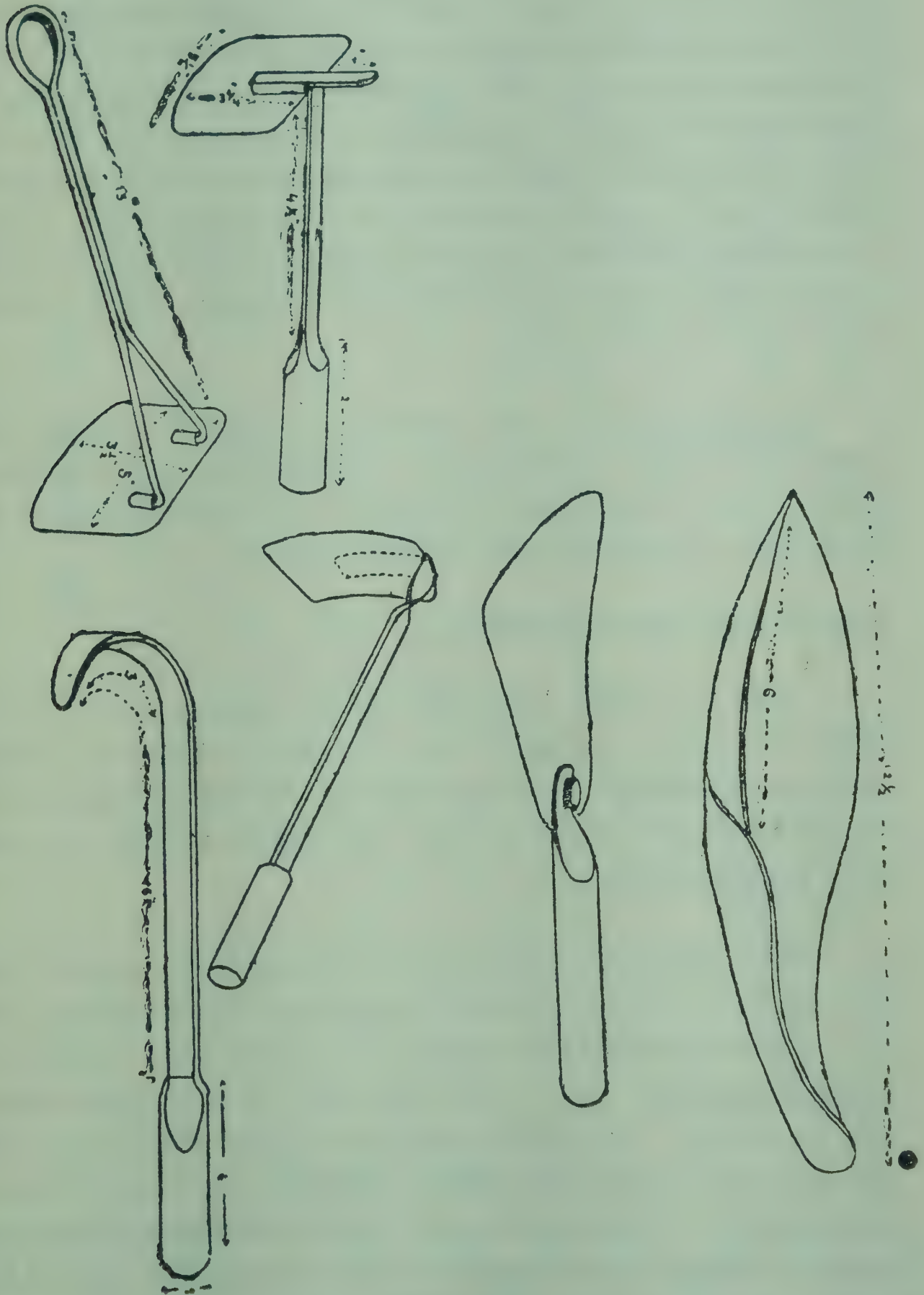
It is very necessary to attach handles on both sides of the faeces-pot. The handle in the front portion towards which the 5" slope has been kept should be of the groove type as is fitted to buckets. With this type of handle in the front no difficulty is experienced even when the pot extends upto the wall. It does not get dirty from faeces. It should be 3" long and 1" broad. Its lower rim should be bent double so that the handle may not be pointed or sharp edged. On the other side a 3" long and 1" broad handle, like the one fitted to doors, should be attached. It should not have a sharp edge. If made of iron sheet, it should be bent semicircularly so that it may not hurt the hands. On this side at a height of 1" from the bottom four or five 1" holes should be made. One inch height will ensure that there is always some water in the pot due to which faeces will not stick to it. There should be no holes in the bottom as these get closed by faeces

and it is also difficult to clean the pot in the absence of water. Owing to the defective construction of latrines, urine and water fall in the pot. They flow out. The sweepers are allotted a fixed number of latrines to clean. The urine and water have to be carried to the faeces depot which takes lot of time. Sometimes when there are no such pots, urine and water are allowed to flow in the gutter. If the sweeper causes the faeces to flow out in the gutter he is fined. In order to obviate these difficulties holes should be made on the sides also.

The bottom of the pot lies on the floor. Due to its contact with urine and water it is likely to give way soon. Therefore its bottom should be fitted with 12" long 1" high iron shaft of 18 gauge. Both ends of the shaft should be bent circularly. The circular portion of the front shaft should be a little higher so that the pot remains a bit tilted. For public latrines the pot should be 18"×9"×7". Round pots give trouble in the maintenance of cleanliness.

CHAPTER XVI SCRAPERS

The implement used for removing faeces from the floor or the pot is called the scraper. The sweepers have to remove



Scrapers of various kinds used for cleaning service latrines

faeces by hand which is a revolting method. Faeces falling on the floor, are cleared with the help of a small broom, broken mudguard of a bicycle or pieces of broken vessels. At some places, the sweepers have to clean the faeces-pots with broken pieces of tiles, tin etc. The scraper has the same importance as the razor has for a barber but there has been no improvement in it. The sweepers improvise scrapers from any thing they can lay their hands on anywhere. In view of this, the Malkani Committee recommended that the sweepers should be provided with scrapers by the municipality. The Government of India has given grants for this purpose to the municipalities who have provided the sweepers with various kinds of scrapers.

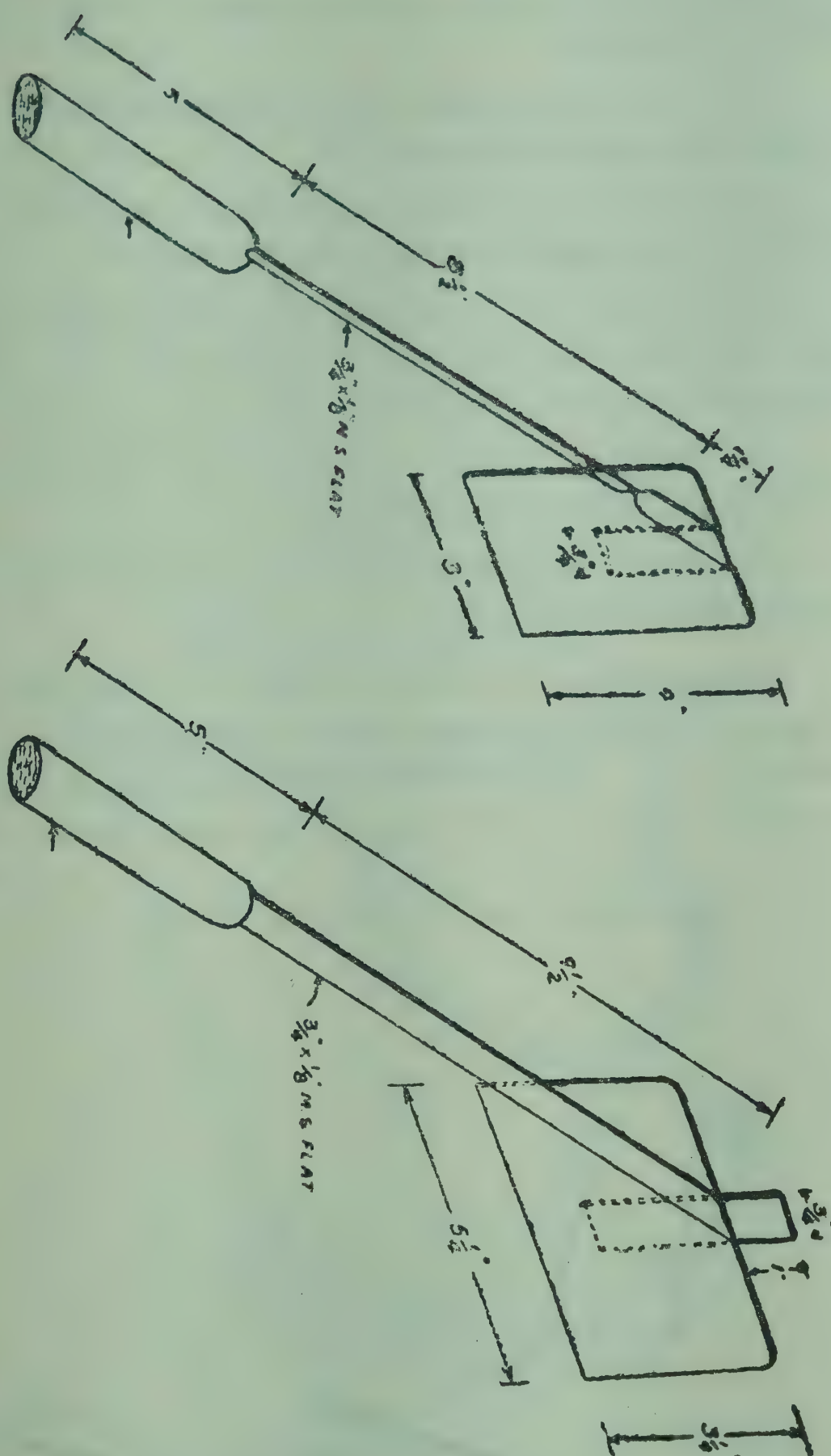
Scrapers which were constructed without taking into consideration the difficulties of sweepers proved to be of no avail. The spade type of scraper will be more useful in cleaning the improved type of faeces-pan.

Dimensions and Construction

Take a 16 gauge iron M.S. piece measuring $3\frac{1}{4}" \times 5\frac{1}{4}"$. Both corners of its upper part should be rounded. In the middle of the plate a groove of the size of the thickness of the handle should be made so that the handle surface may be level with the edges.

A 16" long M.S. plate of $\frac{1}{4}" \times \frac{1}{8}"$ should be selected for the handle. At one end of this plate a 5" long conduit pipe of 1" diameter should be welded. $1\frac{1}{2}"$ of the plate should be inserted inside the pipe. The other end of the pipe should also be closed. The other edge of the plate should be bent $9\frac{1}{2}"$ from the end and welded towards the back of the tin plate upto 2". The remaining 3" portion should be bent upwards as shown in the diagram. This should also be welded. Folding in this way an edge of 1" will remain on the upper side.

डिब्बा साफ करनेके लिये



Scrapers for cleaning pots

Uses and benefits

(1) These are very convenient for cleaning the improved pans. The 1" turned-up edge can be used for lifting the pot from the other side and drag it if it is far inside the latrine.

It can also be used to dig a drain in case of accumulation of water on the floor.

(2) The handle being round does not hurt the hand and is, therefore, convenient to use.

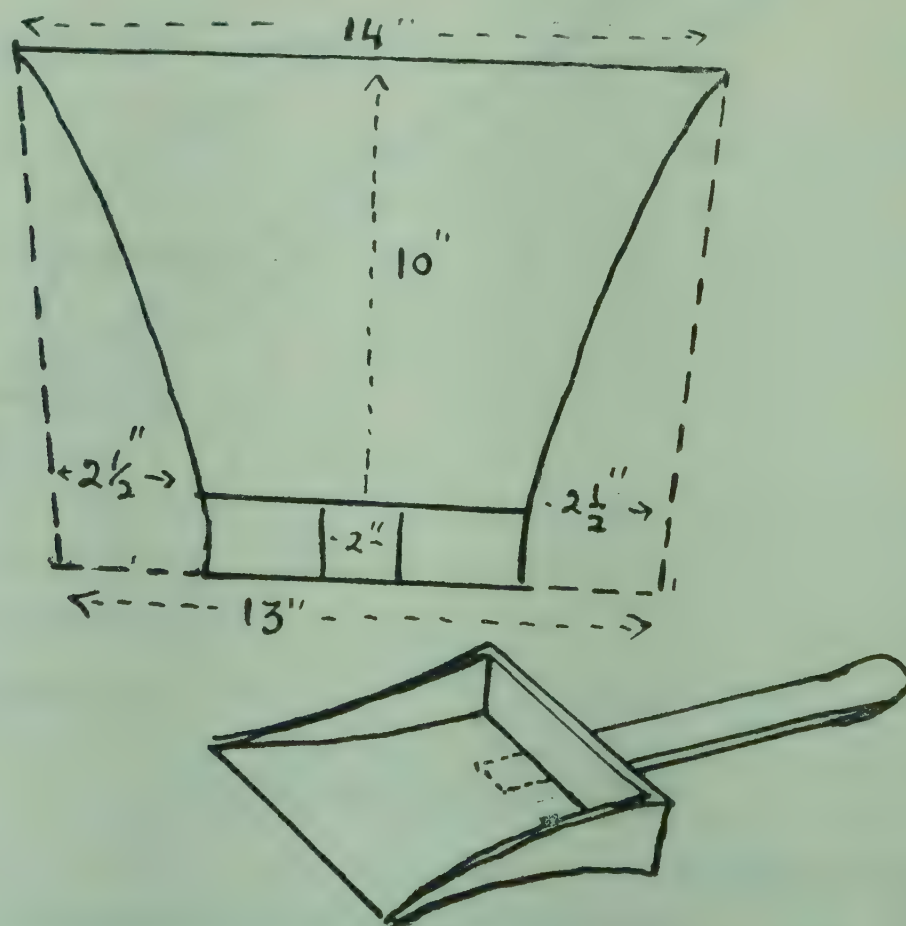
(3) If there is no pot in the latrine this can be used to drag the faeces from the floor on to the "Supri".

(4) If there is no passage for cleaning the latrine, a drain can be dug with it for draining out urine and water whereafter cleaning can be done easily with the scraper.

(5) It helps to load faeces in the wheel-barrow and causes no inconvenience while cleaning.

(6) Local craftsmen can make it for Re. 1 to 1.25. It lasts for three to four years.

Where pots are not kept for faeces, a spade-like scraper as shown in the diagram is used. It is not pointed. Its tin plate is $4'' \times 3''$. It should be slightly rounded off. A handle should be fixed in the $3''$ side and the plate bent as shown in



Fan shaped scraper for removing, faeces from the floor
and its dimensions

the diagram. At one end a conduit pipe handle should be attached. The thickness of the strip and the plate should be as shown in the diagram.

A metal dish of $18" \times 12\frac{1}{2}"$ piece of 18 gauge sheet should be used with this scraper for collecting faeces. $2\frac{1}{2}"$ of the sheet should be bent at the place where it is to be held so that hands may not get smeared with faeces. Handle should be fitted with this part. Both of its parts should also be bent by $2\frac{1}{2}"$.

Scraper for Cleaning Buckets

At many places, round pots, tubs, buckets, etc., are



Bucket for faeces and scraper for cleaning it

placed in latrines. The above mentioned scrapers cannot be used for cleaning them.

This type of scraper can be used for cleaning buckets of the wheel barrows. This will be more useful also for the sweeper who transfers faeces from the barrow to the tanker. Usually, for cleaning such pots, iron sheets of some kind or other are used. After making some improvements these scrapers have been made to make them more convenient to the sweepers.

Construction and use

Take a $16'' \times 1\frac{1}{2}''$ strip of $\frac{1}{8}''$ thick M. S. iron. One end of this strip should be attached to a 6'' long galvanised pipe of 1'' diameter. The strip should be pushed one inch inside the pipe and welded. The other end of the pipe should be closed. On the other side, the strip should be bent 3'' from the end into a semicircle. Its front edge should be rounded. The portion to be bent can be made smaller or bigger according to need. This scraper can be more useful for cleaning the pot after pouring the faeces from it into the wheel-borrow or bucket.

CHAPTER XVII

THE WHEEL-BARROW

The practice of carrying faeces as head-load is still prevalent at several places where service latrines exist. It is inhuman to carry faeces on head or on back. At many places, it can be seen that faeces ooze from broken baskets on the person of the sweepers who are obliged to carry them. Many suggestions have been made by the Enquiry Committee on Scavenging Conditions for ending this practice. It should be our aim to put an end to this practice latest by the Gandhi Centenary.

Various Ways of Carrying Faeces

A drum is placed between five to ten latrines. Faeces from pots are poured by sweepers in this drum. These drums are removed by truck and replaced their after cleaning them at the faeces manure grounds.

In smaller lanes, bullock cart of 30 cu. ft. capacity is plied attended by a sweeper. He takes out the pots from the latrines and empties them directly in the bullock cart. Faeces from places inaccessible to the bullock-cart are collected by him in a bucket having a handle and emptied in the bullock-cart. One such bullock cart is allotted between two or three sweepers. This practice easily puts an end to carrying the faeces as head loads. But the number of bullock-carts should be more so that the sweepers may not have to wait for them.

In many places faeces are poured over garbage. This garbage is carried by bullock carts or on buffalows or donkeys in bags.

Towns where there are many undulations, can employ 'kanwar' (bamboo poles with loads at both ends). A $4\frac{1}{2}$ ft.

long bamboo pole with covered drums or buckets of 4-5 gallons capacity dangled at each end can be employed for cleaning the faeces.

Wheel-barrow

Faeces are carried in various ways in the country. A simple method is its conveyance by wheel-barrow. To stop the practice of carrying faeces on head, the Government of India have given big grants to State Governments for purchase of wheel-barrows.

Six kinds of wheel barrows have been designed under the guidance of the Central Public Health Deptt. A wheel-barrow has been constructed for carrying two drums of 4 gallons each. Wheel-barrows have also been constructed for carrying 4 small buckets on each. A big wheel-barrow for a 10-12 gallon drum for faeces has also been made. Three-wheeler hand-drawn rickshaws with drums of 50-60 gallon capacity are in use where faeces have to be taken to a far off place and the lanes are narrow.

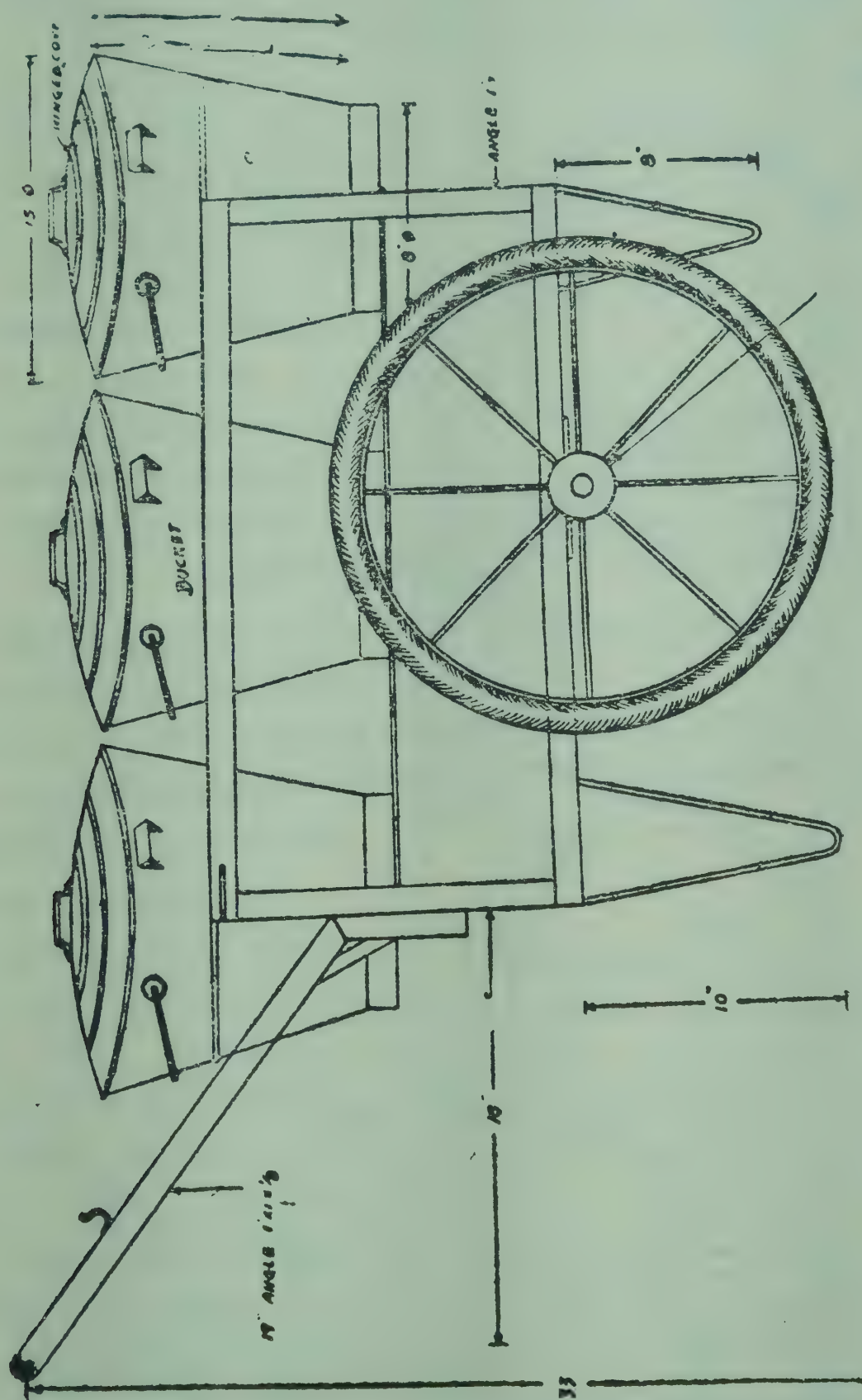
We have here considered the various kinds of buckets, but the wheels of wheel-barrows are also equally important.

Different kinds of wheel-barrows have been made. In some of these small solid wheels of 12" diameter are attached. In others bigger ones are used. Some wheel-barrows have ball-bearings while others have bush-bearings. Some are so constructed that it is difficult even to push them. They have to be dragged somehow or other. Therefore, it is necessary to consider which of them are simple and convenient.

Construction of wheel-barrow

It is easy to put three buckets in a wheel-barrow. The total weight of faeces in all the three should not be more than $7\frac{1}{2}$ gallons as only this much can be easily carried. If two buckets are used it becomes difficult to carry them from the wheel-barrow to the latrine. It is easy to carry smaller buckets. To hold the buckets, these should have iron handles as shown in the diagram. If the cover is fixed to the buckets, it causes

inconvenience to the sweepers while cleaning. At some places, because of the loss of covers due to the carelessness of sweepers, the covers are fixed to the buckets. A little care, however, should solve this problem. The cover should bulge up-ward



Wheel-barrow No. 6. for carrying faeces

and a handle be fixed to it. If it is conical in shape, it will be stronger. The lower rim of the cover should be 1" and should

fit inside the bucket. As the cover is fitted inside the bucket, faeces will not spill out when the wheel-barrow is in motion but will remain inside the bucket.

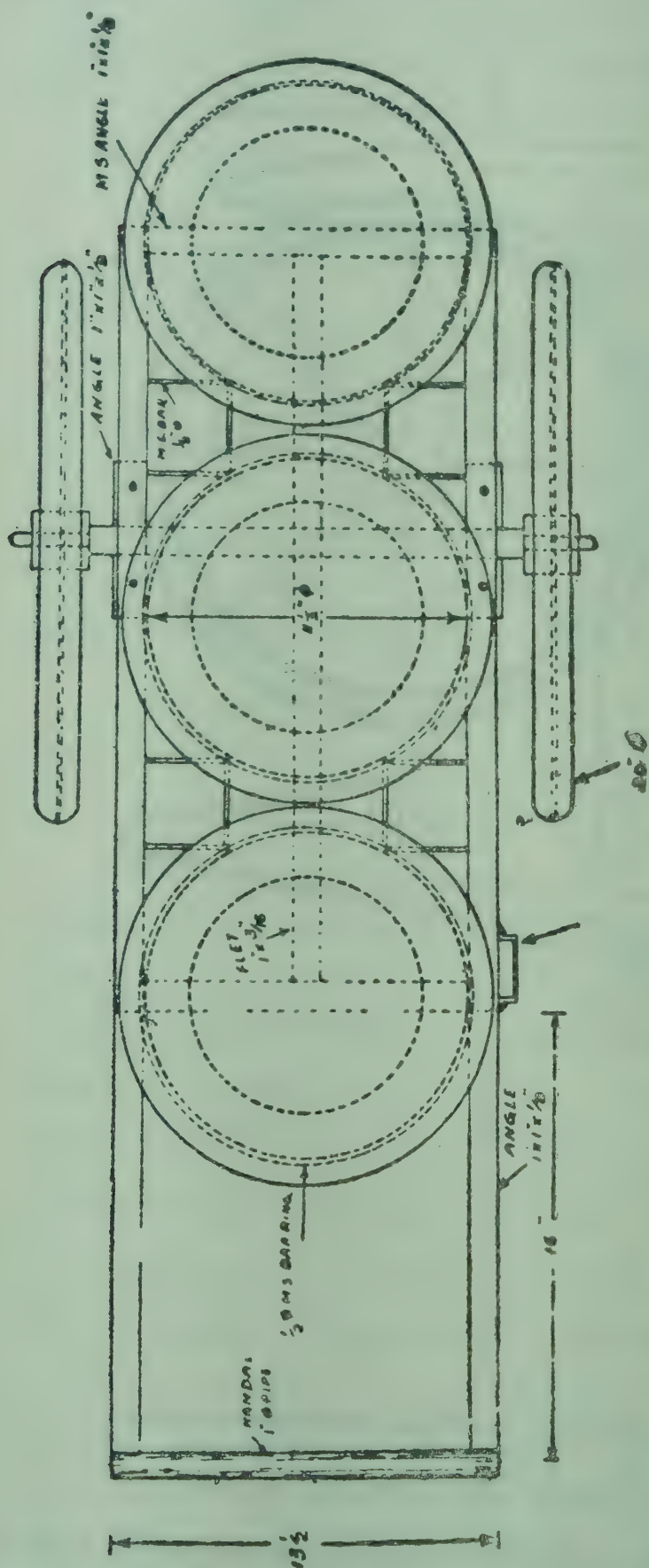
The bucket should be made of 24 gauge galvanized tin sheet. It should be coated inside with dry coaltar 3 or 4 times in a year to avoid rusting.

The bucket should be $\frac{2}{3}$ rd inside the wheel-barrow and $\frac{1}{3}$ rd above it so that it may not topple. The upper rim of the bucket should have galvanized wire so that it may not bend on striking against the tanker.

The bucket should be 13" in diameter on the top and 8" at the bottom. Its height should be 11".

Wheels of wheel-barrow

The sweepers have to face great difficulty if the wheels are of 12" diameter. The roads under the Municipalities are not good uniformly. The wheel-barrows have to be plied on pucca as well as kachcha roads. At places they get stuck in mud and puddles. Taking this difficulty into con-



Wheel-barrow No. 6 for carrying faeces

sideration the latest wheel-barrow No. 6 has been provided with wheels of 20" diameter fitted with solid tyres like those of tongas. This type of wheel-barrow is good. It is strong and durable. To make the wheels durable they are fitted with eight spokes measuring $1 \times 3/16$ inches. A brass or iron bush is also fitted in the centre of the wheel with a hole for oiling. Where bush-bearing is not provided, ball-bearing is used. It is necessary to provide for opening and greasing of the ball-bearing but it should be covered so that dirt may not get into it. It should be periodically oiled.

Axle and stand for Buckets

The axle of the wheel-barrow should not be welded with the body. Many a time when the axle goes out of order, the entire wheel-barrow becomes useless. Therefore, the axle should be joined to the frame by nuts and bolts on both sides so that it can be removed and repaired when required.

Sometimes the faeces buckets are kept directly on the plate laid over the axle. The result is that when the wheel-barrow is in motion, faeces spill over the buckets due to jerks. The plate for placing buckets should, therefore, be laid a little higher over the axle.

Wheel-barrow frame

In order to make the wheel-barrow cheap, the frame is made of conduit pipe instead of iron-angle. But because the sweepers do not use them properly and there being no facilities for repairs they are soon broken. These should, therefore, be constructed with $1" \times 1" \times 1/8"$ M.S. Angle as shown in the diagram. In order that the wheel-barrow may not turn upside down, stands of M.S. bars of $\frac{1}{2}"$ diameter should be constructed on both sides underneath the body. The front stand should be 10" and the rear 8" high above the ground level. The handle of the wheel-barrow should be 16" long and made from a 19" long $1" \times 1" \times 1/8"$ angle as shown in the diagram. For gripping it in the middle a $13\frac{1}{2}"$ pipe of 1" diameter should be joined. The handle should be at a height of 33" from the

ground level. The rings for keeping buckets should be of $11\frac{1}{2}$ " diameter and made from bars. By this arrangement $\frac{2}{3}$ rd of the bucket will remain on the stand. This frame will be quite strong.

Necessary Information

1. Separate arrangements for parking of wheel-barrows is necessary.
2. For washing the wheel-barrows, arrangement for water supply should be made otherwise the sweepers would either clean them at odd places or leave them dirty. They would even take them to their basti where children play with them.
3. Every wheel-barrow should bear either its own number or that of the sweeper concerned. If they are kept together, their care and repair becomes easy. Where their number is large, they should be parked near public latrines.
4. They should be periodically oiled or greased. The buckets should be changed when broken.
5. Their movement is facilitated by large wheels. They can move along even on uneven and kachcha roads.

CHAPTER XVIII

UPRIGHT BROOM

Brooms are required for cleaning any place. Brooms of straw, coconut and palm leaves are used for domestic sweeping. Many improvements are being effected even in such brooms. This is necessary as well. Mostly, the long upright-broom is not considered appropriate for use in families. This is considered somewhat unholy. There are people who take it as a sweepers' broom.

Generally, the upright-broom is not much in use for sweeping the roads. Owing to old habit, the sweepers in many places do not want to use it. The upright-broom, as a matter of fact, is in all respects useful for the sweeper. It is also necessary to know how it is made. Its technique is easy. The sweeper can make it himself. The sweepers co-operatives of cottage industries can also fabricate and supply them to the Municipalities. Sometimes the upright-brooms obtained from contractors are not good and the sweepers are reluctant to use them. When knowledgeable workers make them, naturally they will be good.

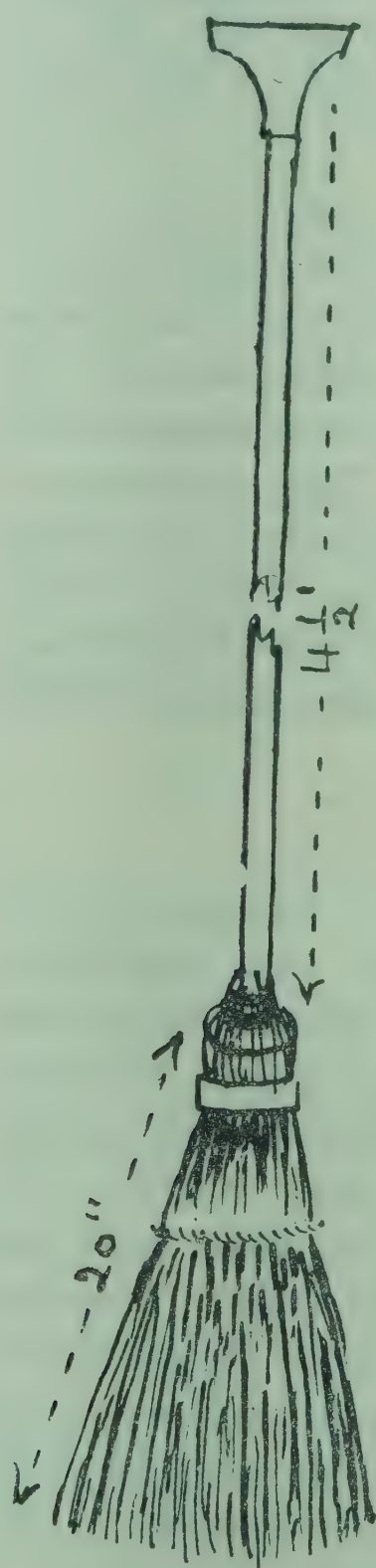
Necessity of Upright-Brooms

Our roads are not good. People make nuisance on the roads. They spit, urinate, throw refuse, ease themselves at any and every place. These things get mixed with earth and rise with dust. The sweeper bends and cleans the road with one hand. This raises dust which is harmful for health. Germs of many diseases find their way in their nostrils. By bending the back also does not get rest. Working with one hand puts strain on it and it takes longer to clean. Sweeping by bending is really back-breaking. The small broom can be used only for sweeping dust where the roads are pucca and the garbage is not thrown on them. They can also be easily employed for cleaning of gutters, latrines and urinals.

It is easier to clean by both hands with the upright-brooms. One does not have to bend the back. There are lesser chances of dust and dirt getting into the nostrils. The dust raised is also not much. The lower part of the broom being broad, cleaning can be done more easily. It also is less tiring.

Varieties of Upright-Brooms

There are three types of upright-brooms in vogue according to the conditions prevailing in various provinces. In their construction coconut or bamboo twigs are used.



(a) Varanasi Upright-Broom

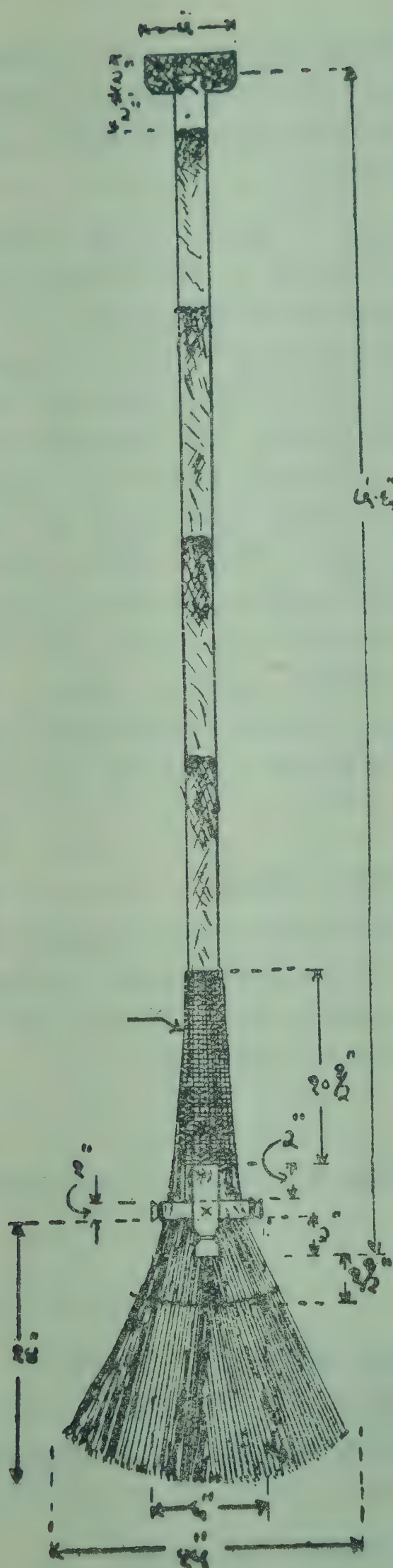
A handful of coconut twigs, weighs 250 to 300 gms. They are secured with an iron ring. Keep the thinner end of the twigs downward. Fit the twigs in the ring at one level. Take a bamboo with tapered end and thrust this end in the middle of the sheaf of twigs in the ring and hammer it down. In the ring or near it, fix a piece of wood with small nails. The breadth of the lower part can be adjusted by sliding the ring. The twigs are tied together with a string so that they may have the necessary strength and may not slip out. The dust and light-garbage from pucca roads can be swept with ease with this broom. It is difficult to remove wet and heavy garbage by it. Kachcha paths can be easily swept but lot of dust is raised. It can be used for cleaning gutters by adjusting its lower width at 12 inches.

(b) Fanshaped Upright-Broom of Bombay

In Bombay lot of garbage falls in between high buildings. Water too

Varanasi Upright-Broom

Bombay type upright-broom



flows unchecked in gutters. Therefore the garbage gets wet. It collects on both sides of roads. Owing to vehicular traffic it does not lie in the middle of the road. For cleaning this kind of garbage, a heavy broom is required. This broom has more twigs and the fanshaped lower portion is broader. It can be used for pushing the garbage with foot. Sweeping is mostly done by men. Women carry and load the garbage in wheel barrows etc.

Necessary Material

Thin twigs of coconut weighing 350-400 grams, each 2' to 2½' long; two bamboo splinters each 6" long 1" broad and 2 gauge thick; Bamboo pole 5½ ft. long with 1" to 1½" diameter; 15 to 20 ft. long coir string; 8' to 12' long cotton string; 5 to 10 ft. fine wire; and a 5"×4" piece of tin for scraper.

Construction

Twigs should be smoothened with a knife which would help the broom to be tied tightly. The tip of their thicker ends should be scorched in fire so that they may not split. On both ends of the

splinters two-gauge deep grooves should be carved to prevent the wire or string from slipping. Both the splinters should be tied with wire at each end. In between and 10" below, the twigs should be tied with a fine string.

After inserting all the twigs, a damboo pole with its front end spilt into two should be thrust in the portion containing the splinters and the twigs above the splinters be so arranged that they get wrapped round the bamboo evenly. This part should be tied round so tightly that the twigs may not fall out. The split end of the bamboo pole should be so tied with a wire to the splinters that the fan of the broom does not shift from the middle. After being tied the fan will open out 15" like a peacock's tail. At the other end of the bamboo pole a 5" × 4" piece of iron sheet should be fixed. This will help scrape off the dirt sticking to the road. As this piece is like a spatula, the sweeper need not have a tin plate in hand. This broom can be used on pucca roads only. It can remove wet garbage. This cannot serve the purpose for kachcha roads.

Upright-broom for Kachcha-Pucca Roads

The upright-broom of the Bombay type cannot be useful for kachcha roads of small towns and villages. A broom which sweeps the garbage and leaves the dust behind will be more useful. By and large, it is used everywhere.

Material for Broom

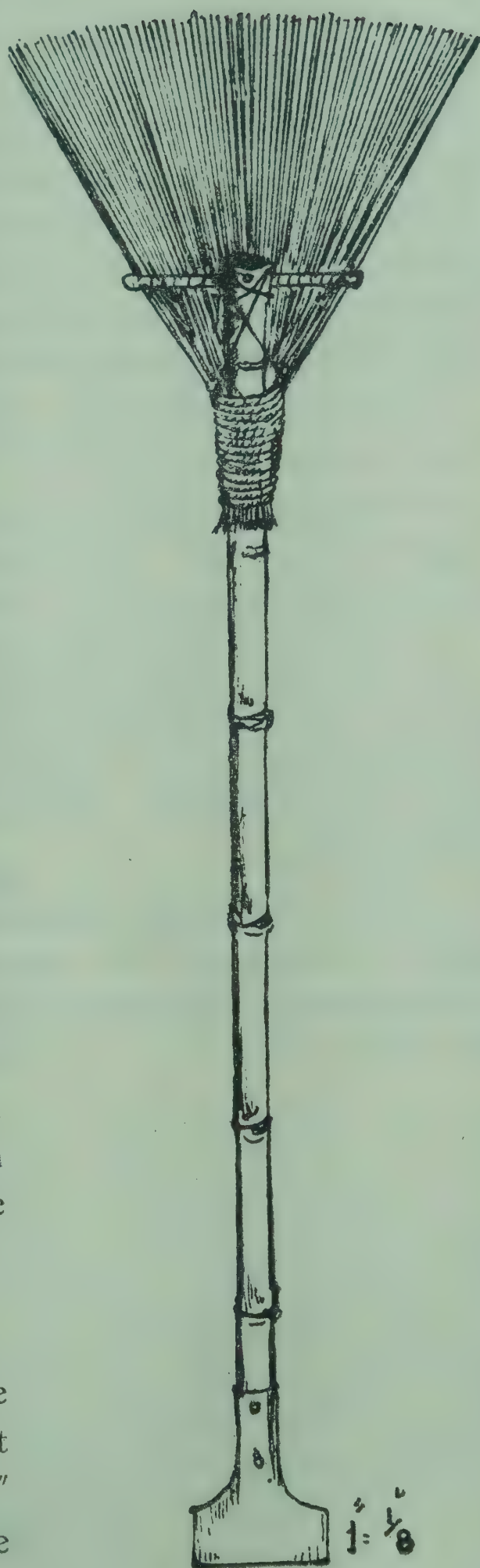
- (1) 2 to 2½ ft. long thin twigs of coconut or bamboo—200 to 300 grams.
- (2) 12 ft. coir string.
- (3) 12 ft. cotton string.
- (4) Two splinters of bamboo— $10\frac{1}{2}" \times \frac{3}{4}"$.
- (5) 6 ft. fine galvanised wire.
- (6) Bamboo pole 4½ ft. to 5 ft. long having a diameter of 1" to 1½".
- (7) Knife etc. for splitting bamboo into twigs.

Procedure of making the Broom

The twigs should be smoothened with a knife. They become stronger by doing so. Leaving a margin of $\frac{1}{2}$ " from both ends, grooves should be made on the bamboo splinters. They should be so adjusted that there is no intervening space when the two splinters are joined together. One end of the splinters should be tied together with a cotton string. Place this end under the toe of the foot and taking 10 twigs at a time in such a manner that the thicker portion is on one side, spread them between the splinters and secure them with cotton string. Repeat this operation 30 times with ten twigs every time. In this way 30 sets of 10 twigs each will be fastened on the splinters. Thus 300 twigs in all will be tied to the splinters. The end should be tied with a string and both ends of the splinters secured with wire.

The Broom-Stick

The thicker portion of the bamboo pole should be split upto a length of 1 ft. A 1" groove should be made at one



end. The split end should be inserted in the splinters containing the twigs to protrude 1" below the splinters.

A coir string should be wound round the thinner end of the twigs $3\frac{1}{2}$ " below the splinters as shown in the diagram. The string should first be dampened so that it may tie tightly. If tied like this, the front portion will automatically fan out to 15" to 16" breadth. A groove should be made 1" from the thicker end of the pole which is towards the fan-end of the broom. A wire should be tied round the groove so that the fan and the splinters remain tightly fixed to the pole.

At one end of the pole a 5"×4" iron sheet should be fixed to serve as a scraper.

This broom can be usefully deployed. It lasts for more than 3 to 4 months. When the twigs become useless they can be replaced by others.

The length of the lower part of the broom's fan being 10" the twigs remain strong and garbage can be easily cleaned. Its breadth being 16", it sweeps a wider area at one stroke. It is also easy to handle. It is less tiresome and can be used by women also.

The municipalities should be persuaded to use upright-brooms of any kind. The sweepers should also be told about its usefulness. This type of broom should be used in training institutions also.

CHAPTER XIX

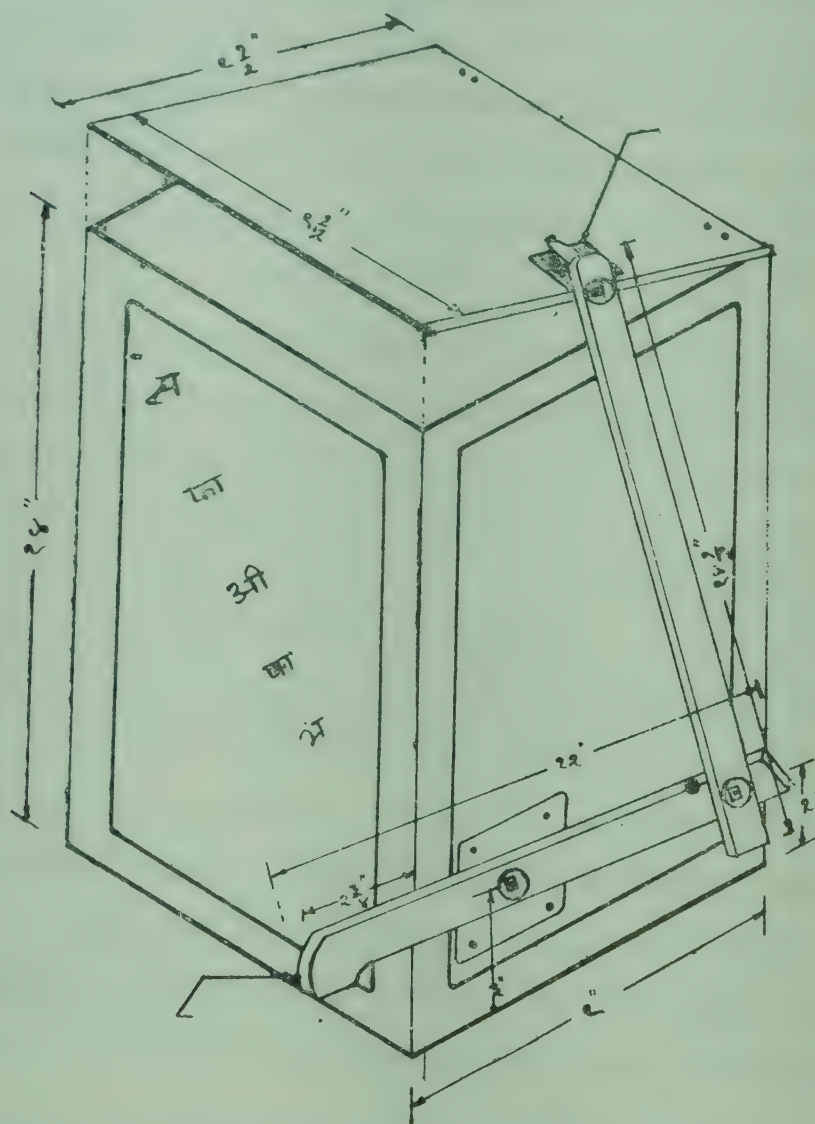
DUST BIN

Everyone wants his premises to be clean. But, after sweeping, they throw the garbage anywhere and everywhere. The shopkeepers throw the refuse on the roads which have already been cleaned and it remains there till the next cleaning time. Some people are in the habit of throwing the refuse in the others' courtyards. This habit is evident in schools, in offices, in almost every place.

Every family, shopkeeper and institution should understand that throwing of garbage indiscriminately in public places not only increases the work of sweepers but also spreads germs of many diseases. This amounts to polluting clean and orderly place. Garbage should be thrown at the proper and rate specified place only. Refuse is estimated to collect at the of half to one pound per head. It can be a source of national income if used properly. It can be converted into good organic manure. Pieces of glass and tin can be utilized by factories to increase their production. Paper after putrefaction can be used in making toys etc. If garbage is not properly utilized then it is mere filth destined to increase disease. It is more harmful than faeces in this respect.

Let us consider what type of dust-bins should be used in houses, offices and institutions. We should give up the habit of throwing useless things at random. If we change our behaviour, the children will learn better manners and there will be more cleanliness and less untidiness. What is more, the sweeper's work-load will be reduced. In foreign countries, the problem of cleanliness of roads does not exist. People do not throw refuse on roads or in lanes. This has become part of their social behaviour.

For collection of garbage in the lanes, garbage drums are placed. If space is available then trailers are kept. Garbage from lanes is conveyed by wheel-barrows to the trailer. Trailers of garbage are driven to the manure dumping ground by trucks. In many towns, a wall of $3' \times 3'$ in a corner of the lanes is made to enclose a space of $6 \times 8'$. This space is used for throwing garbage.



Dimensions of dust-bin

Every family should have a dust bin which should be emptied in the garbage drums. This practice will lead to the cleanliness of roads and facilitate the work of sweepers.

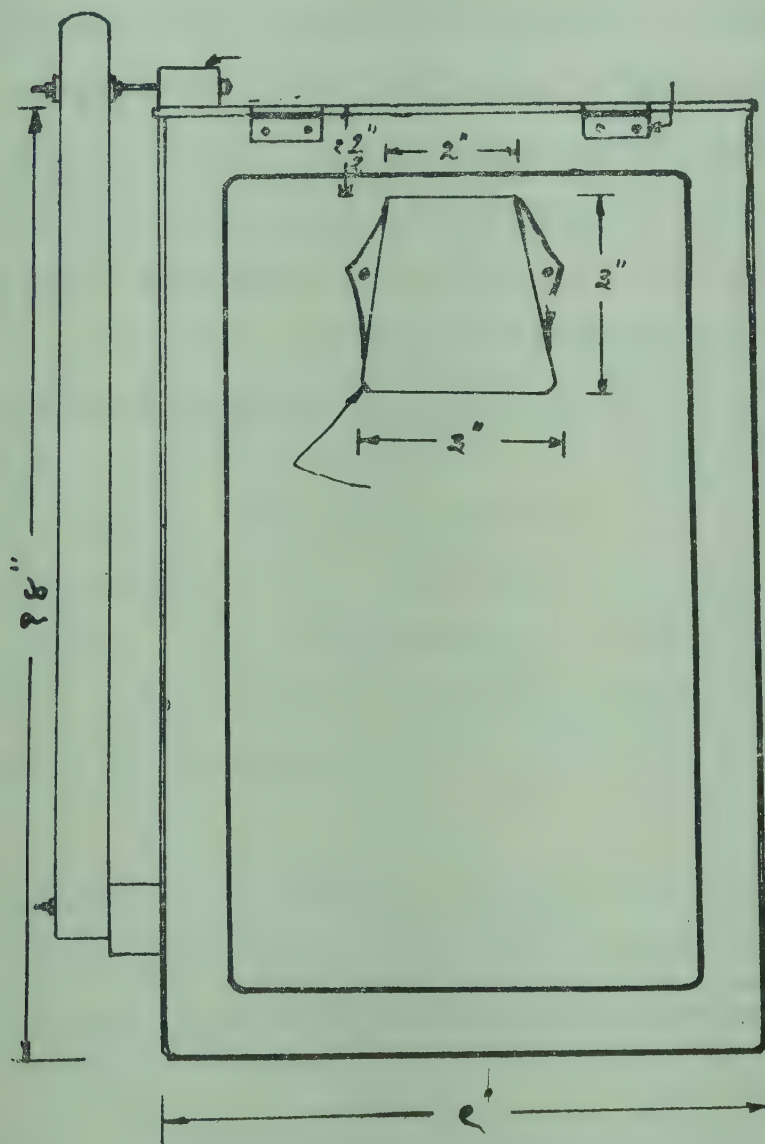
Types of Dust Bin

Canisters of kerosene oil, soap-boxes or wooden boxes kept in a corner of the house can serve as a receptacle for refuse. All kinds of refuse—pieces of paper, twigs used as 'Datun', peeled skins of vegetables' and fruits etc.—is collected in it. As these receptacles do not have covers, flies sit on

them. Receptacles whose covers can be opened by pressing a lever with the foot are better. There are two or three kinds of such receptacles. Here is a description of a simple and cheap one.

Materials for a Dust-Bin

- (1) An empty container of kerosene or vegetable oil measuring $9" \times 9" \times 14"$.
- (2) Wooden pieces $\frac{3}{4}"$ broad $1"$ thick:—one of $14"$ length as vertical strip and one $12"$ long horizontal strip as in the diagram. One of $14\frac{1}{2}"$ as vertical strip and one of $10\frac{1}{2}"$ for footrest in the front and two of $11\frac{1}{2}"$ as transverse pieces.



Back portion of the dust-bin

- (3) Nuts-bolts of $\frac{1}{4}"$ size:— one $3"$ length, two of $2"$ length and one of $1"$ length.

(4) A piece of tin $9\frac{1}{2}" \times 9\frac{1}{2}"$ for cover of the container.

(5) Rivets, nails and hinges.

Construction of Dust-Bin

Cut open the lid of the container and fix a cover of $9\frac{1}{2}" \times 9\frac{1}{2}"$ size with hinges to it.

Three inches above the ground level on right side of the container, put a mark $2\frac{1}{2}"$ towards the rear and make a hole of $\frac{1}{4}"$. Towards the right side and 5" from the front of the cover, rivet a strip 1" long with a $\frac{1}{4}"$ hole so that a 3" nut may be fitted in it.

In a 12" piece of wood, make a hole at a distance of 5" from one end another 1" from the other end. In another piece of wood $14\frac{1}{2}"$ long make holes at 1" from each end.

The 12" piece of wood should be so fixed with nut and bolt in the right hand side hole of the container that $2\frac{1}{4}"$ portion of the wooden piece should project for being pressed by foot. To the hole at the other end of this piece join one end of the $14\frac{1}{2}"$ piece with a nut and bolt of $2" \times \frac{1}{4}"$. The hole at the other end of this piece should be connected with the tube rivetted on the right side of the cover with a nut and bolt of $3" \times \frac{1}{4}"$. In this way the receptacle No. 1 will be ready. If we press the protruding part of the transverse piece with foot its rear part will rise and will lift the vertical strip also. As a result, the cover will open. When the foot is pressed the cover opens and when it is removed it closes by lever action.

In diagram No. 2, on the front side a horizontal strip is joined with the strip on the left and on the right side also a similar strip is joined at the same distance as on the left with nut and bolt.

The first model is opened by pressing the right hand strip whereas the second model is opened by pressing by foot the front strip. In both the models the same system of lever works. These receptacles will cost Rs. 4/- and Rs. 4.50

respectively. They can be opened without using hands by pressing with foot and will close as soon as the foot is removed after dumping the refuse.

When the receptacle becomes full it should be emptied in the compost pit or the garbage cart in the lane. The receptacle should be coated, both inside and outside with oil. When it becomes useless, the rivets etc., can be removed and the wooden frame fixed to another container for use in its place.

Instead of the wooden strips shown in diagram No. 1, iron strips can be used for making the receptacle.

By introducing some modifications they can be made simpler still.

For cleaning the garbage, a broom with handle is used. For filling it, a fan shaped "supri" with a handle can be used.

It should be insisted that the receptacle for garbage, broom and "Supri" are kept at a proper place in every house, hostel, room, office and school.

This is conducive to cleanliness and lessening of filth. It indirectly helps the sweepers in their work.

CHAPTER XX

SMOKELESS OVEN (CHULHA)

Women in homes have to work in kitchens full of smoke and hot as a furnace. Much of their time is spent in such kitchens. This is very pathetic indeed. Students living and cooking their meals in hostels also share the same fate.

The Gramodyoga Sangh (Village Industry Association) Maganvadi, Wardha started popularising the smokeless oven twenty five years ago. Dr. Raju in Hyderabad also performed experiments in this line and gave publicity to this type of oven. The smokeless oven, made in Maganvadi is called 'Magan Chulha'. Considerable improvement in and publicity about the smokeless oven has been done by the Training Centre at Bakshi-ka-Talab, Lucknow, Shahpur Centre in Saurashtra, the Gram Sevika Training Centre in Kolhapur and Safai Vidyalaya of Biara.

The smokeless oven is very cheap. Its construction is also easy. Its benefits are many but the public has not utilised them much. This shows that people have very little knowledge of elementary science. A person trying to make a smokeless oven does not succeed for lack of knowledge of elementary science.

Any woman will point out the following defects in the family oven :—

- (1) Eyes get irritated from the smoke of the oven.
- (2) Its heat gives lot of trouble; sometimes there is likelihood of the clothes catching fire.
- (3) Clothes and walls get blackened by its smoke.
- (4) Lot of fire-wood is consumed.

These difficulties can be solved by using the smokeless oven. With a little training women themselves can make this oven. It can be made with local material.

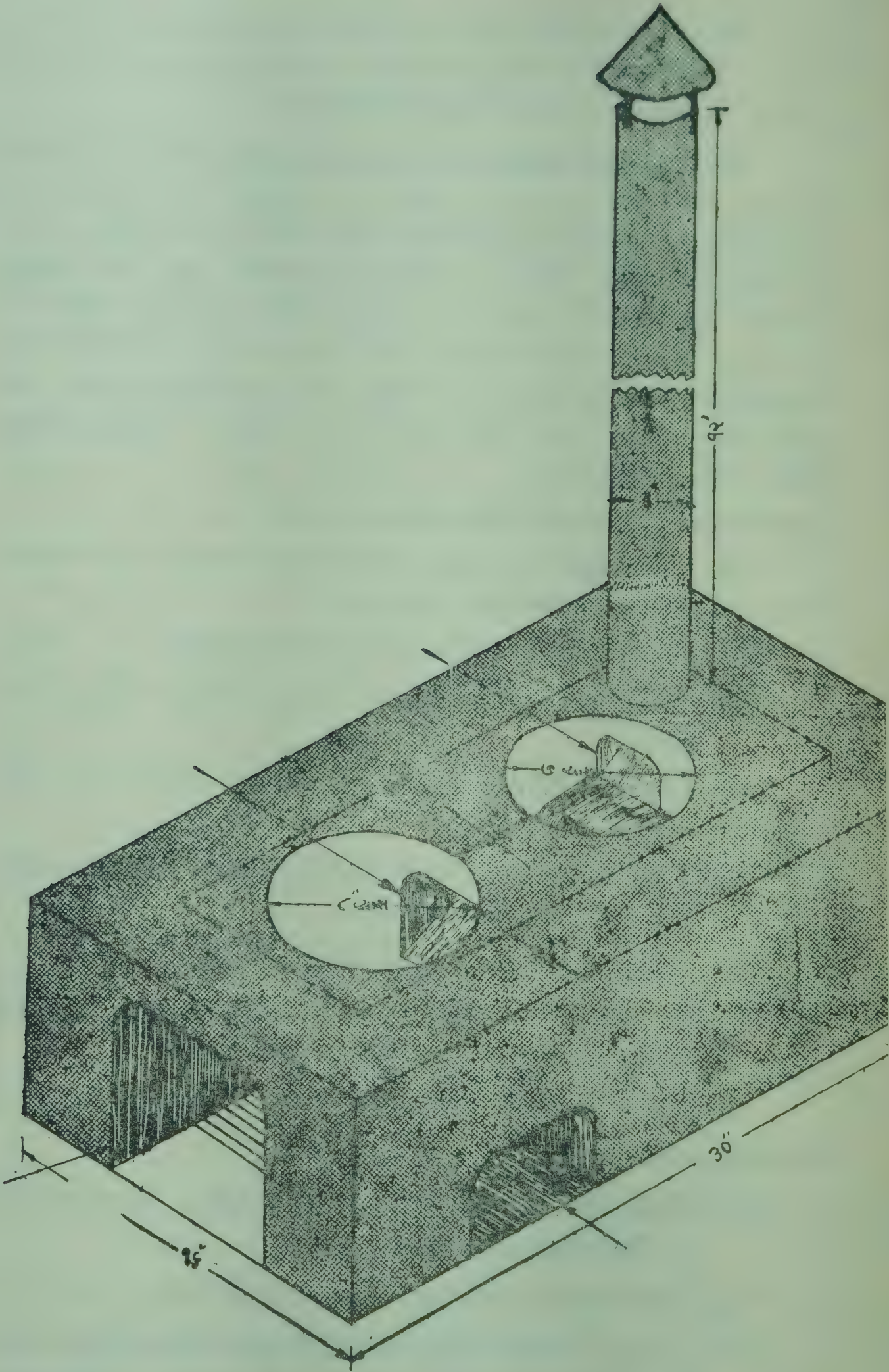
We shall here consider the most simple and more useful of the smokeless ovens in vogue at present in the country. Cast-iron sheets with big or small holes for the smokeless oven are also available. Rings of different sizes for big and small utensils can also be had. The oven can be made from a 12-gauge sheet, which rules out any possibility of the oven breaking. Such ovens are suitable for students hostels. In ordinary homes even brick and mud ovens will last a long time with a little care.

Important Features of Smokeless-oven

- (1) The pipe is connected to the oven so that smoke may automatically get out.
- (2) It prevents irritation of eyes from smoke.
- (3) Cooks are not exposed to the hazards of heat and fire.
- (4) Clothes, utensils and houses are not blackened with smoke.
- (5) Two utensils are kept simultaneously on the smokeless oven which saves time.
- (6) There is some saving in firewood also.
- (7) Its size can be adjusted to be big or small according to the number of members of the family.
- (8) It can be made from local material by hand.

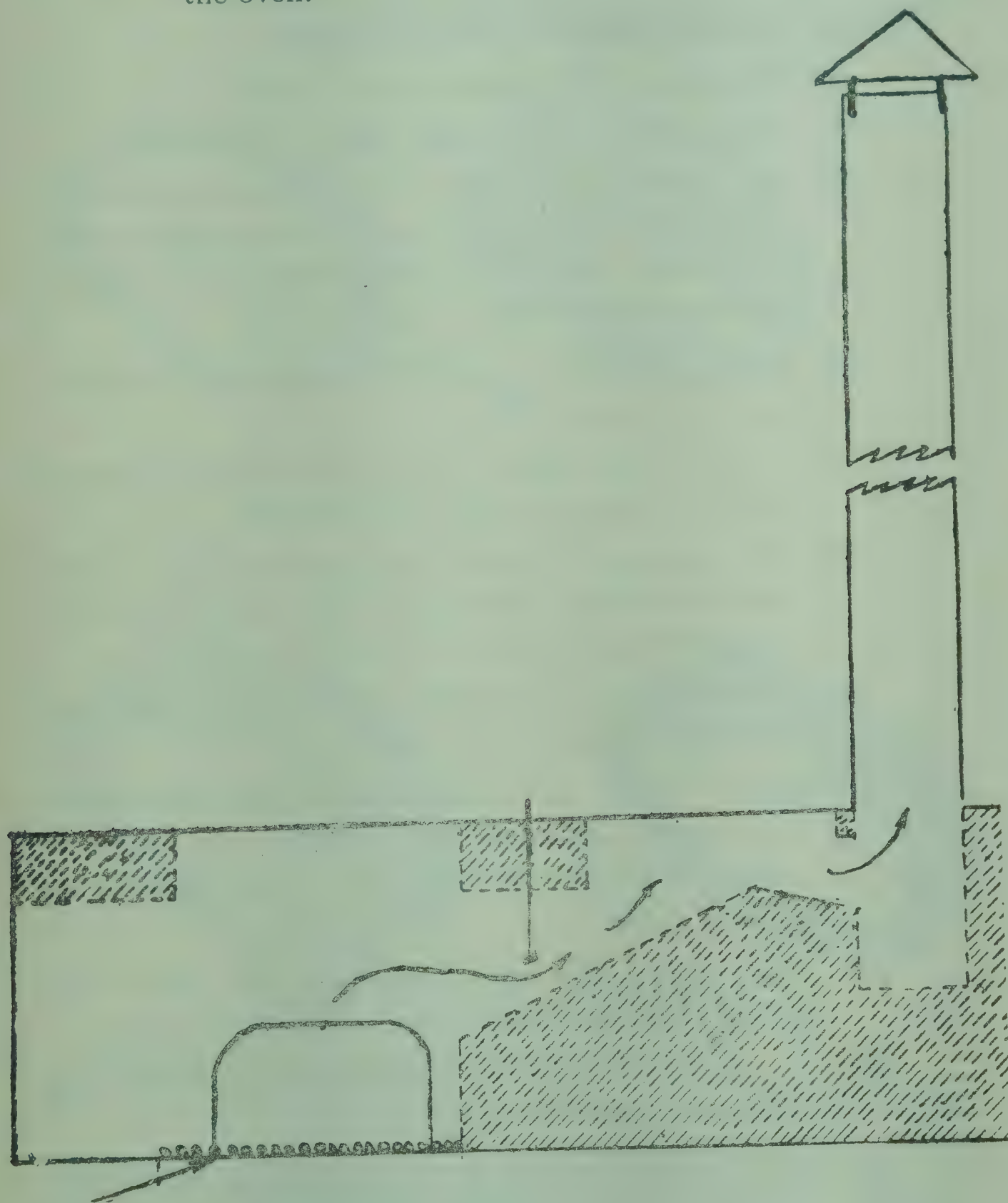
Necessary Material

- (1) 10-12 baskets of fine potter's clay, from which earthen pots are made.
- (2) Two baskets of dung of horse or donkey.
- (3) A bag of fine chaff of wheat or any other grass which can easily rot when mixed with mud. It prevents cleavage of the mud on drying.



Family smokeless-oven

- (4) 10' to 12' long pipe with a diameter of 3" made of tin, cement, or round tiles.
- (5) Iron rings for putting utensils of different sizes on the oven.



Cross section of the inner passage of a smokeless-oven

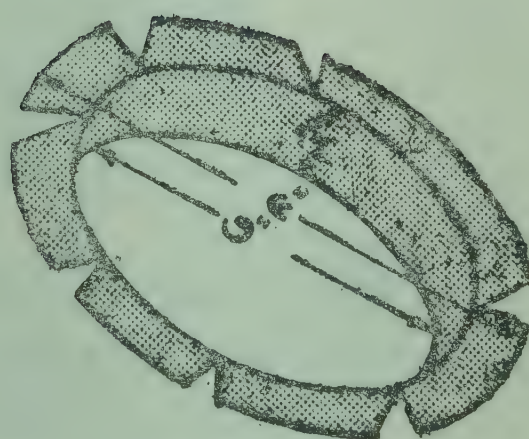
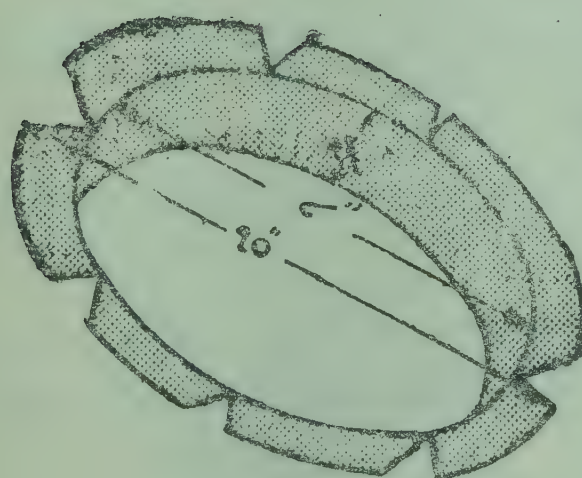
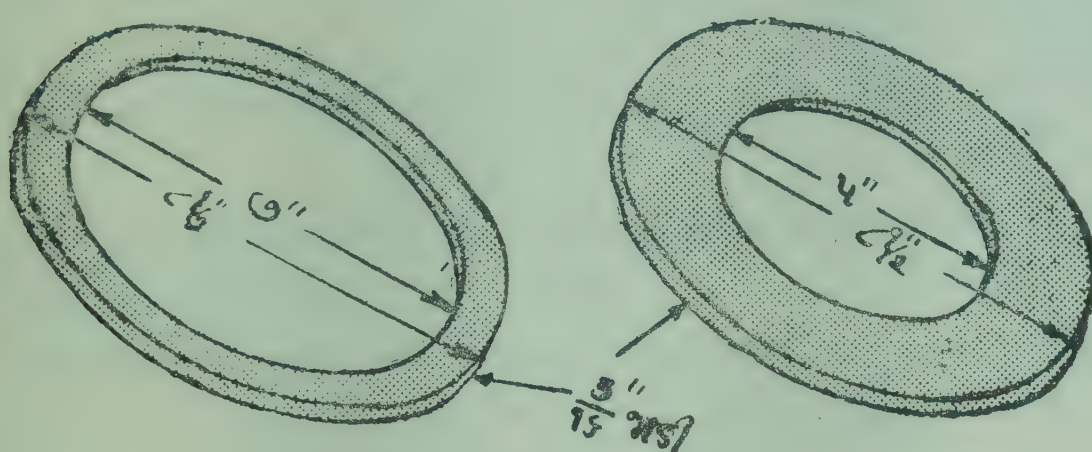
Dimensions of a Smokeless Oven (for Families)

After preparing the mud a slab of the following dimensions should be built keeping in view the direction of the

wind and convenience of the cooks. The oven is to be cut out of it. But first, lines should be drawn with the help of a compass as shown in the diagram and then mud removed from the slab where necessary with the help of a knife.

- (1) A slab of mud $30'' \times 16'' \times 9''$ (height)
- (2) First oven :— $8''$ diameter and $8''$ depth.
- (3) Second oven :— $7''$ diameter and $4''$ — $5''$ depth.
- (4) The distance between the two ovens should be of atleast $3''$ to $3\frac{1}{2}''$. If the distance is less than this then the utensils will collide with each other; if it is more then the second oven will get less heat.
- (5) Space for fitting the pipe for smoke :— $3''$ diameter and $4''$ — $5''$ deep.
- (6) A border of atleast $3\frac{1}{2}''$ on all sides of the upper surface of the oven should be provided.
- (7) The passage of flame from the first to the second oven should be $5''$ broad and $4''$ high with an upward gradient towards the second oven.
- (8) The outlet for the smoke from the second oven should be $3''$ broad and $2''$ high.
- (9) There should be a mud screen in the passage between the two ovens so that the flame may touch the utensil on the second oven. It should be sloping on both sides.
- (10) The passage for the flame from the first to the second oven should also have an upward gradient.
- (11) A passage of $7\frac{1}{2}'' \times 7\frac{1}{2}''$ should be made for feeding firewood in the first oven.
- (12) Any material which produces flame on combustion can be used as fuel for smokeless oven.
- (13) In order that the circular mouths of the ovens may not break, rings made of $1'' \times 1''$ angle iron are put in them.

Pucca smokeless ovens of the above size can also be built. It can be a brick work with middle portion made of mud. In the upper portion a rectangular cement-concrete plate can be placed on the oven in place of the rings. An iron sheet with holes of the size of utensils can also be placed on the oven.



Various sizes of rings for ovens

Smokeless Oven for Boarding Houses

In boarding houses where firewood is used instead of soft-coke it is very essential to have smokeless ovens. These should be constructed as shown in the diagrams. Heat is preserved longer in ovens built from bricks and mud. A rectangular iron sheet of 12 gauge is used instead of the round plate (Tawa) for baking bread. The sheet type oven takes less space and consumes less firewood. More loaves can

be baked simultaneously. The plates for boarding house ovens are now made from cast iron. Rings of various sizes of vessels are also available.

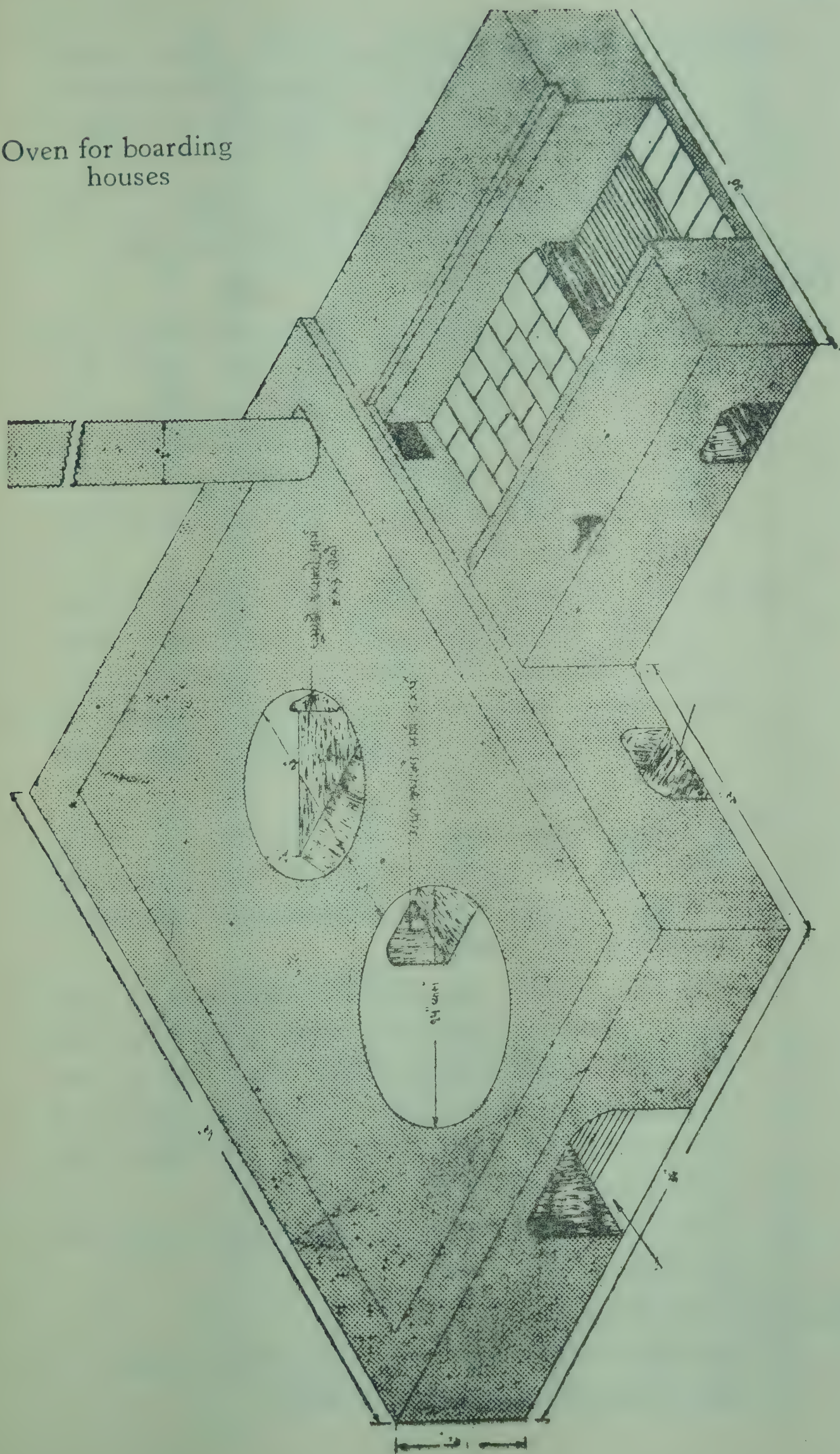
Ovens for Boarding Houses of 30 to 40 Students

- (1) Dimensions of ovens :—52" long, 39" broad and 9" high.
- (2) Dimensions of first oven :—15" diameter and 9" depth.
- (3) Dimensions of second oven :—12" diameter and 6" depth.
- (4) Passage for flame from first to the second oven 8" broad and 6" high.
- (5) Distance between the two ovens :—4" to 5".
- (6) Outlet for smoke :—4" in diameter and 5" deep.
A shade of tin or cement-concrete slab should be provided in the kitchen and arrangements made for the smoke-pipe to go above it.
- (7) The outlet for smoke from the second oven should be 5" broad and 3" high.
- (8) A cement or tin pipe 10-12 feet high and 4" in diameter.
- (9) Rings of 15" and 12" diameters of 1"×1" angle-iron for being placed on the ovens so that their round edges may not break.

Dimensions of Plate Ovens for Baking Bread

- (1) Tin plate 27"×15" of 1 to 1½ gauge thickness. All the edges should be bent 1 or 2 gauges so that the plate may not buckle from heat.
- (2) Space for oven :—27" long and 30" broad.
- (3) Dimensions of oven when ready :—27"×12"×8" (height).
- (4) Inlet for firewood 12"×8".

Oven for boarding
houses



- (5) Outlet for smoke should be 3" x 2". There should only be 3" open space. The rest of the space excepting the inlet for firewood should have a higher gradient.
- (6) The same pipe is used as outlet for smoke in both the smokeless oven (Chulha) and the plate oven.

Technique of Smokeless Oven

- (1) Smoke is lighter than air. By suction of air, the flame touches the bottom of the first vessel then goes up the raised path to the second oven. It comes in contact with the second vessel and the smoke goes out through the outlet pipe. There being a continuous draft of air, the oven does not need to be fanned.
- (2) In order to check the flame from passing without touching the second vessel, a mud screen is provided. The flame, therefore, rises up and goes out after coming in contact with the second vessel. It is a characteristic of the smoke and the flame that they go upward.
- (3) Owing to the pressure of air, the flame from the first oven goes to the second. A mud or tin screen should be provided to regulate passage to the second according to its needs.
- (4) The space for the second vessel should not be kept open, otherwise heat and smoke will get out from there. It should be kept closed when not in use. A drum should be welded to the smoke-pipe if it is made of tin and filled with water. The water gets heated from the heat of the smoke.
- (5) The height of the chimney, its diameter and inlet for firewood are related.

Necessary Information

- (1) All the firewood should not be stoked at once. It should be added according to need.

Material Required for the Smokeless Oven for Boarding House

No. of Students	Dimensions of the oven				Sand		Earth	Cement	Iron rings diameter		Iron plate	Chimney
	Height	Length	Breadth	Space	Brick	Buckets			First oven	Second oven		
25 to 40	10"	44"	33"	44"×33"	150	15	1	1	16"	13"	27"×15"	10' to 12'
40 to 60	10"	46"	33"	46"×33"	200	20	1½	1	18"	15"	30"×18"	10' to 12'
10 to 100	12"	4½"	3¼"	41'×3¼'	200	25	1½	1	21"	18"	36"×20"	10' to 12'
Plate oven	—	—	—	—	100	10	10	1	—	—	—	—

- (2) To prevent the edges from breaking, rings should be used where vessels are kept. Bigger or smaller rings can be used according to the size of the vessels.
- (3) If only one oven is to be utilised then, leaving a passage as an outlet for smoke, 2/3rd of the passage should be closed. The space for putting vessels should also be closed.
- (4) After cooking, the oven should be coated with a mixture of dung and mud everyday.
- (5) Ashes should be removed to keep the passage clear for air.
- (6) The passage for the flame and smoke should be kept clean. The pipe gets choked by soot which blocks the passage. The chimney should be cleaned from inside every two-three months by a bamboo with a piece of cloth attached to it. It will be advantageous to take the pipe above the ceiling.

CHAPTER XXI

VARIOUS IMPLEMENTS FOR CLEANING

For any kind of work suitable implements should be developed. To work with improved implents affords pleasure as well as ease in the performance of the job. Suitable improvements are being made even in the jobs which were once considered as dirty. Improved devices for hair cutting have been installed in barbers' saloons. Mechanical devices have been developed for washing clothes. Similarly, improvements in and development of the means of cleansing are equally important. Users of the improved implements should also show the necessary enthusiasm. Facilities for adequate training in the manufacture and use of those implements be provided. Sweepers of the older generation do not like the upright-broom whereas younger people use it. We have to consider the small implements for cleaning the refuse and garbage in the same way as we did about the improved facilities for cleaning of faeces.

With the use of these implements one does not have to touch the refuse. They are easier to handle, less tirsesome and facilitate quick work. Means of conveyance of garbage and faeces like tankers, trailers etc. are of course necessary.

Implements for Garbage

1. Two Pronged Fork

Different kinds of implements are used for loading garbage in trucks or trailers. In some places spades are used, in other shovels. Wet garbage contains various kinds of materials and the spade is not of much use in its handling. The workers have to exert more. The garbage can not be easily unloaded. The two pronged fork is more useful for unloading it from trucks, trailers, bullock carts etc. at the manure centre.

For lifting garbage also it is useful. It is extensively used in cities like Bombay. Garbage is filled in the cane basket by placing it near the foot.



Two pronged fork for garbage

2. *Toothed Shovel*

Spades are mostly used in our country for filling garbage in baskets. The entire refuse is dragged towards one's feet and then loaded. But for wet garbage in the cities the toothed shovel is better than this. The refuse has not to be dragged towards one's feet. The basket can be filled while standing on one side.

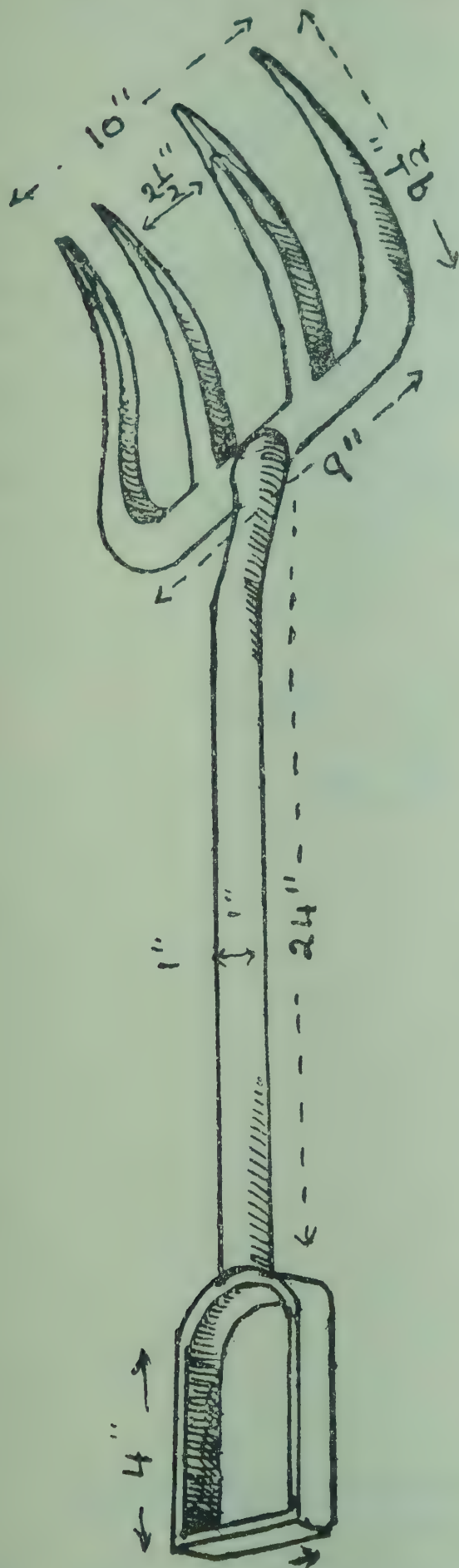
For filling garbage in the pits at the manure centre the toothed shovel is very useful. The garbage can be thrown in the pits while standing on the side.

Sand and fine wet refuse can be lifted with the shovel. For filling refuse and garbage cane baskets and metal dishes (Tasla) may be used.

3. *Boot for Workers at the Manure Centre*

Gum boots are provided to the workers at the manure centre in order that their feet may not come in contact with dirt or get hurt from broken pieces of glass iron etc. They have not, however, proved to be useful because refuse and dirt find their way in them from above. They are torn by pieces of glass or iron. They should instead be provided with rubber and canvass shoes with laces, known as hunter boots. These can be tied upto the ankle and are easy to wash. Those who load refuse and garbage should also be given boots.

4. Hand Gloves



Toothed shovel for lifting refuse

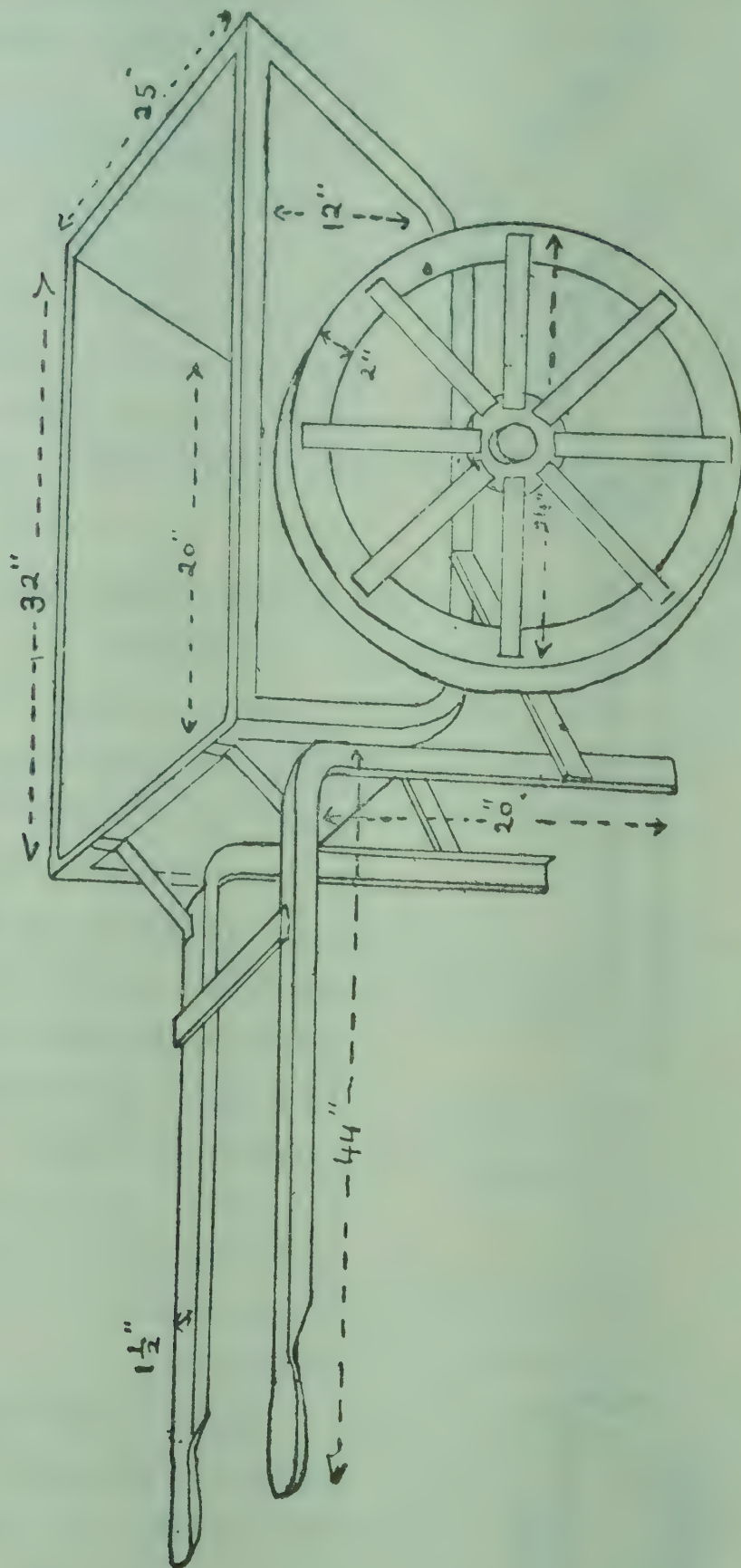
Sweepers who clean faeces should be given hand gloves. Those who clean public latrines must be provided with gloves. Gloves of number 10 size which are made of black rubber and are acid and alkali proof should be given. They should not be long, otherwise they will be a hinderance to work.

5. Hand Cart for Conveyance of Refuse

The refuse which is gathered after sweeping the lanes is collected in metal dishes (Tasla) with the help of two pieces of tin, loaded into small hand carts (Thela) and conveyed to the refuse depot. In many places the refuse is carried in bamboo baskets or canisters. In several places big carts are built which have to be drawn by two workers as bullocks.

Carts with small wheels serve the purpose well where the roads are metalled, but they are not of much use on unmetalled roads. Carts shown in the diagram which can be

used both on metalled as well as unmetalled roads are more useful.



Hand cart with big wheels and long handles for conveying refuse

These carts can carry garbage from 3 to 5 cu. ft. The longer the handle, the easier it is to draw. Their wheels which are made of iron, being big, it does not require much

force to draw them. This cart is made of 14 gauge sheet and angle-iron and is therefore more lasting.

6. *Implements for Gutter Cleaning*

The Varanasi upright-broom serves well for cleaning gutters. For taking out mud etc., from the gutter a 9" long and 3" semicircular piece of 14 gauge sheet may be taken. A wooden handle may be fixed to it. It is easier to take out mud and garbage from semicircular gutters with the help of these semicircular spades. Where the gutters are broad, a 6" \times 12" plate of 12 gauge sheet is attached to a 5 feet long 4 gauge bar and used as a spade. In such a condition implements which can be used while standing can be devised.

CHAPTER XXII

SOAKAGE-PIT WITH SIEVE

In village we come across refuse, faeces and mud everywhere. People do not mind this. The thought of an appropriate place for throwing refuse or for easing oneself never occurs to us. We are used to this state of affairs. We do not know how to provide outlet for water from the bath room. Some people wash their clothes and clean utensils in the bath room. The entire dirty water spreads on the path-way and turns into puddles. We are satisfied with flow of the dirty water out of our own houses. Ultimately where does it go is none of our concern. There is not the least consideration for public health.

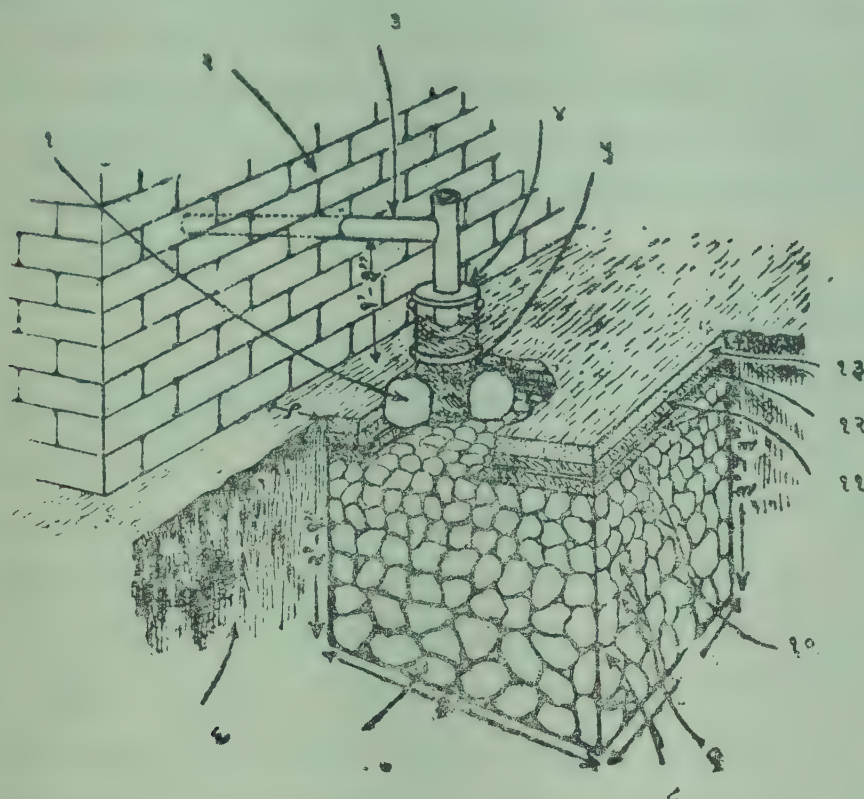
Pucca Tank

A pit is dug and filled with pieces of bricks or stone where water from the house gutter comes out. The water is allowed to flow into this pit. Being open, dust and dirt fall into it and give bad smell after putrefaction. It breeds mosquitos also. In four or five months, when the pit gets filled up, all the pieces of stone have to be taken out and replaced by new ones. People get tired of repeating this process again and again. Well-to do people construct 10 to 15 feet deep and 5-6 feet wide tank and make the sides pucca with bricks or pieces of stone and let the water to flow into it. In the rainy season the water is allowed to go out. This tank costs Rs. 200-300. Everybody has not got the means to construct it.

Cheap and Useful Soakage Pit

A soakage pit can be made in every house. It only involves labour, Nothing has to be brought from outside. Everything is available in the village. This pit neither breeds

mosquitoes nor flies. It serves the purpose very well for five to seven years.



Soakage-pit

(1) Big stones around the earthen pot. (2) Wall of the house. (3) Gutter. (4) A container having a hole in the bottom and cover with handle. (5) An earthen pot with holes in the bottom. (6) Portion of earth that has been scooped out. (7) Inside construction of the soakage pit. (8) Round pieces of stone 5" to 6" in diameter. (9) Round pieces of stone 4" to 5" in diameter. (10) Round stones of 3" diameter. (11) Vegetation that do not putrefy. (12) Thick gunny cloth. (13) Wet Earth.

Dimensions of the Soakage Pit

Where generally 20—25 buckets of water flow, a pit $3' \times 3' \times 3'$ should be constructed. It should be constructed 9" from the place where the gutter comes out of the wall. It should be so arranged that the gutter falls inside the pit, which is 3'—3" on its front side. If the wall is built of mud then the portion adjacent to the pit should be made pucca with bricks or stone. As there is a slope the water will not get into the wall.

Requisite Material

(1) Various sizes of bricks or round stones from a river. (2) Vegetation that do not putrefy e.g. 'mehndi' branches of silk cotton tree, bark of coconut trees. (3) Pucca earthen pot with a broad mouth. (4) A container of three 'ratal'. (5) Gunny cloth large enough to cover the mouth of the pit.

How to make the pit

Leaving a space of 9" from the wall, a pit $3' \times 3' \times 3'$ should be dug with the necessary slope. After cleaning the pit, round stones of $5" \times 6"$ diameter which are found in river beds or pieces of bricks should be filled upto 10". The next 10" should be filled up with bricks or stones of 4" to 5" diameter. Further 10" space should be filled with bricks or stones of 3" diameter. After filling the pit upto 30" in this manner with bricks and stones, an earthen pot with a large mouth and 5 or 6 holes of $\frac{2}{3}"$ or $\frac{3}{4}"$ diameter in the bottom be placed on the stones where the water falls from the gutter. Stone pieces of 4"—5" should be placed round the pot so that it may not be tilted. A netting of the bark of coconut should be placed inside the pot. The container with the hole in the bottom and a handle should be placed on the pot.

The pit should be filled with stone pieces upto 30". The remaining 6" of the pit should be covered with a 2" to 3" thick layer of unputrefiable vegetation. Then completely cover the pit with the gunny cloth. Then another layer of similar vegetation should be arranged upto 2"—3" thickness. Thereafter, completely cover the pit with a layer of mud 2"—3" thick. After putting dry earth upto a height of 2"—3" above the ground level, the pit should be closed. By placing stone pieces round the pot, it should be so arranged that the water falls in this only.

Scientific Principle

Upto 3 ft. the aerobic bacteria devour the pollution in the water and make it clean. They can go upto 3 ft. only as

they can get air only upto that depth. If the pit is deeper than this then the process of cleaning of water will not take place. The polluted water will seap into the soil and affect the nearby wells. Therefore, it is not good to dig a pit deeper than 3 feet. It should be 5" broad but, it can be made as long as is convenient.

Usually a pit of the above dimensions serves a family of 7 to 8 members for 5 to 7 years.

The water in the gutter contains ash, mud and oily substances. This water falls in the container from where after filtering through grass and vegetation etc., it falls into the pot. The water then filters through the bark of coconut, grass etc. placed in the pot. The clean water flows down to the stone pieces. The pebbles have been arranged in the order small, medium and large size in the pit and the water while negotiating them gets cleaned as in the rivers. Whatever waste remains in water adheres to the pebbles and becomes clean. The stone pieces are arranged on the principle of filtration. All kinds of soil have poracity. The pit being closed from above, refuse and dust do not get into it. As bigger pieces of stone are at the bottom, there is more space between them. When the water falls from above, the air goes up and because the upper surface of the pit is closed it exerts a little pressure on the water below. The water, which has become clean, is absorbed in the soil because of its poracity.

In between the layers of the unputrefiable vegetation gunny cloth has been placed to cover the pit so that the refuse from above may not get in. Since the gunny cloth is in between the unputrefiable vegetation, it is not easily spoiled. The mud coated on the vegetation continues to stick to them and there is less poracity from the upper surface. The mud on the pit being at a higher level than the ground, it exerts pressure and the pit remains strong on the top. The

rain water does not go into it. It is so strong that even a bullock cart can safely pass over it.

A grating should be fitted over the gutter to prevent garbage etc from flowing down. In order that the pit may not have to be cleaned again and again, a container having a bolt and 4 or 5 holes should be placed over it. The entire rubbish will stop there. The grass in the container and the pot should be changed every 15-20 days. Grass and bark of coconut are the heart of the soakage pit because if the water is not filtered in the pot then all the pores in the soil will be closed.

The pot should be cleaned when mud etc. collect into it and the holes should be opened. After five or six years when the pit stops soaking water, it should be opened up and cleaned. The stone pieces should also be taken out and cleaned. The moss should be removed by scooping 3-5 inches on all sides. The pit should be allowed to dry in the sun for four or five days and then refilled as described above and used again.

1. Pebbles and bricks should be placed in the pit after cleaning it. Take care, that earth does not fall into it while laying the stone pieces.

2. Rough and round pebbles are considered good. If bricks are placed in the pit these should not be kachcha. If mud is adhered to the stone pieces these should be cleaned before use.

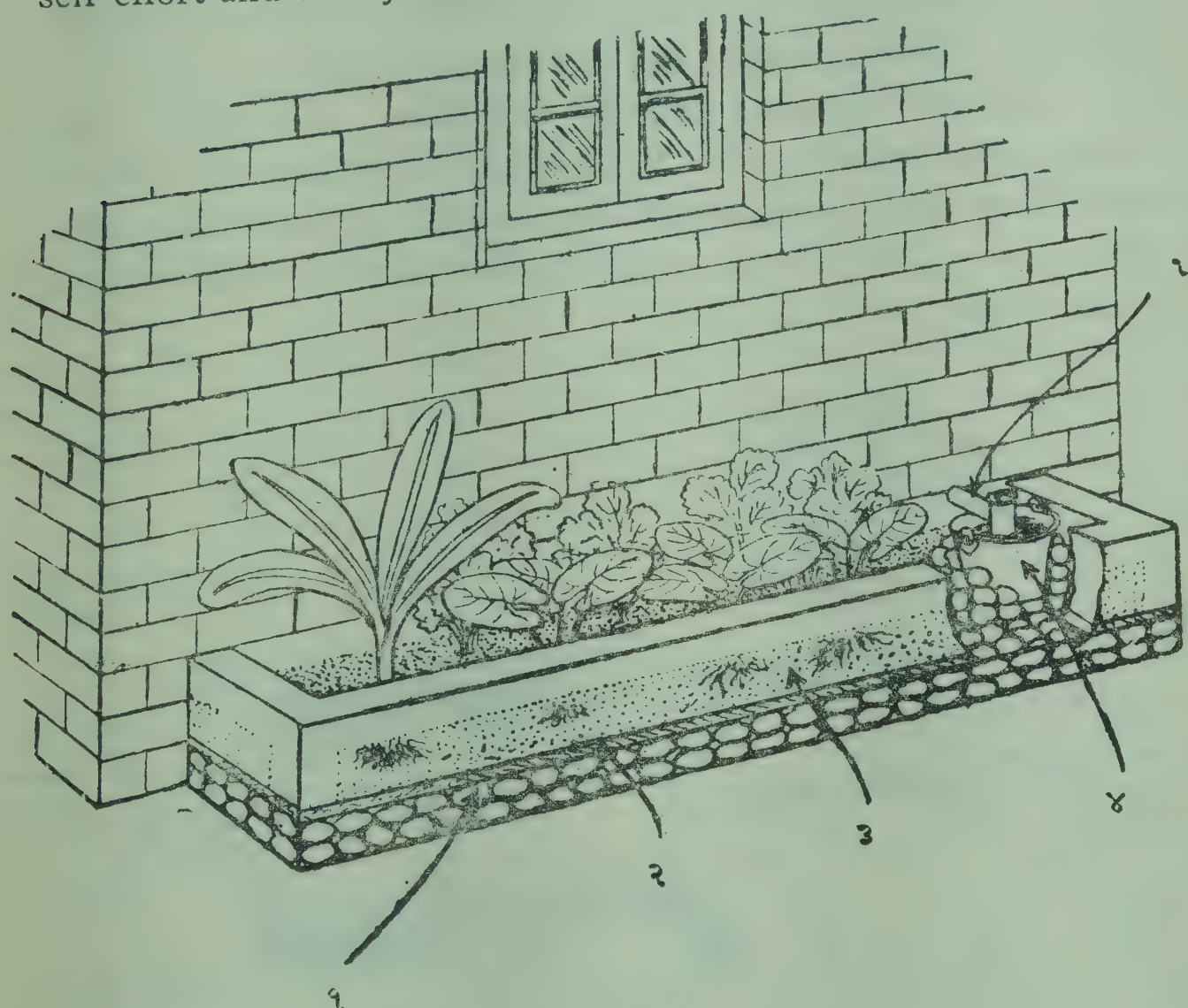
3. The earthen pot should be coated with coaltar or lime so that worms may not breed. Do not use D.D.T. or phenyle.

4. Soakage pit can be built in all kinds of soil, though, to some extent, it depends on the absorptive power of the soil. The pit should be dug according to the condition of the soil, but it should not be more than 3 ft deep. If the soil is gravelly, the soakage pit can be constructed above it. Vegetables etc. can be sown. The excess dirty water that may flow into it would dry up in the sun.

5. In rainy season, if the rain water flows through the same gutter then the mouth of the pit should be closed and the water allowed to flow out.

6. If unputrefiable vegetation is not available then the gunny cloth should be used after treating it with crude oil or tar.

In this way you can improve your health with a little self-effort and save yourself from mosquitoes and flies.



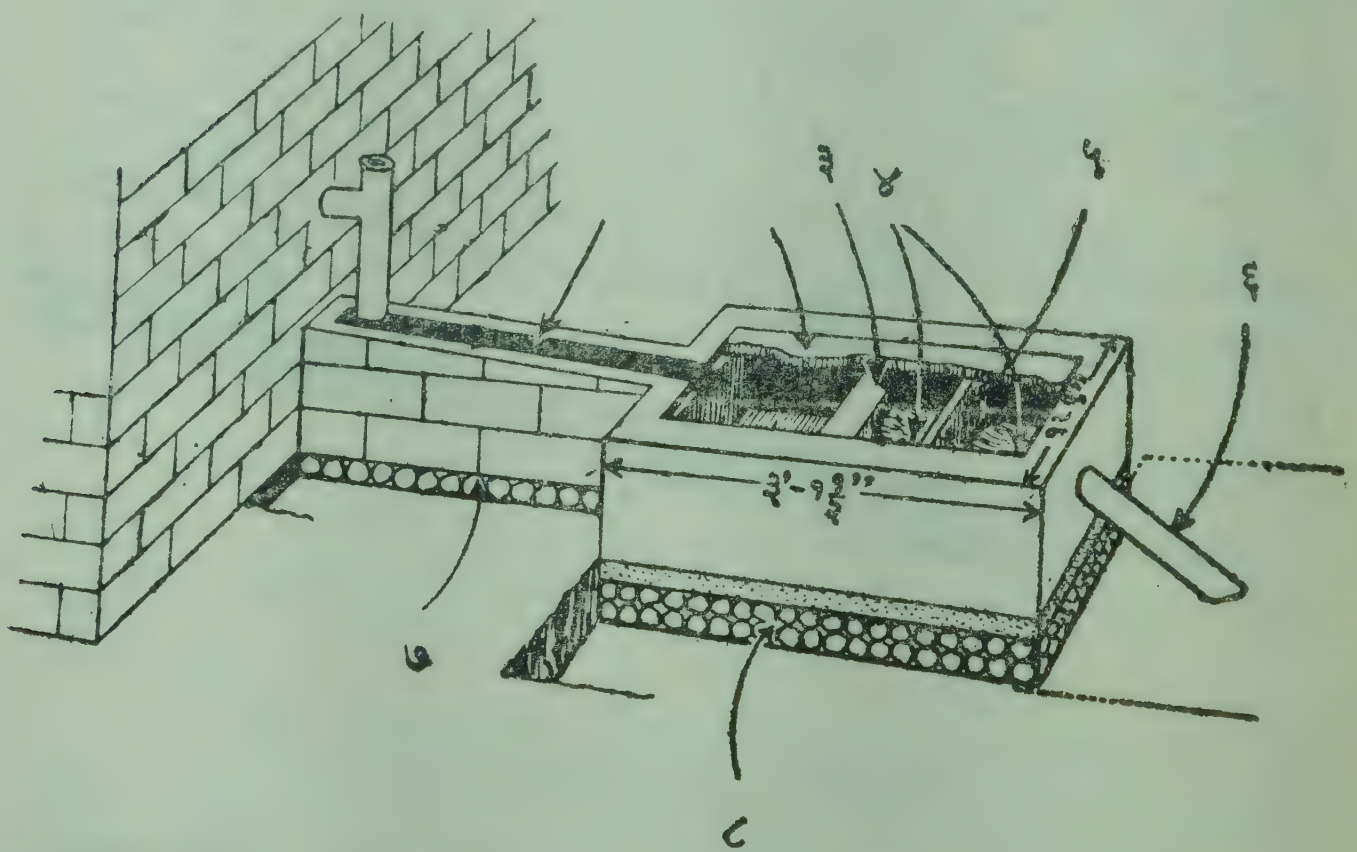
Soakage pit on gravelous soil.

1. Stones of various sizes as in soakage pits. 2. Vegetation that does not decompose. 3. Soil. 4. Bucket containing grass with holes in the bottom. 5. Pipe from the gutter.

CHAPTER XXIII

SOAKAGE CHANNEL WITH SULLAGE TANK

Soakage pits can be built in every house for waste water. But such small pits cannot be of much use near public wells where a great deal of waste water flows. In such places pits have to be built like big channels, which are called soakage channels. Sullage tanks have to be made to cleanse and filter the water before flowing into such channels. In soakage pits a pot with holes is used for filtration of water. As a lot of water flows into soakage channels, a sullage tank is provided instead of a pot. Such a contrivance is called soakage with sullage tank.



Sullage tank

(1) Channel for the waste water from the gutter. (2) Cover of the sullage tank. (3) $4\frac{1}{2}$ " wall. (4) Grass, leaves etc. (5) 1" thick plank. (6) Pipe to convey water to the soakage channel. (7-8) Foundation work.

Construction of Sullage Tank

Function of sullage tank: The function of a sullage tank on a big scale is the same as that of the pot on a small scale. The sullage tank intercepts ash, mud and oily substances in the water and allows the cleaned water to flow to the soakage channel. Soakage channel is built around the well and the water allowed to flow into the sullage tank. Gutters from bath-room and pantry are also connected to the sullage tank. Four or five feet away from the tank or where the water falls in the channel, a pit $3' - 1\frac{1}{2}'' \times 1' - 9''$ and $1' - 6''$ deep should be dug. A layer $6''$ to $9''$ deep of brick pieces etc. is laid at the bottom of the pit and is plastered to make it strong. A $4\frac{1}{2}'' \times 4\frac{1}{2}''$ wall should be made all round. It should be $9''$ upto the channel and $3''$ above it so that it is 1 ft.

The inner dimensions of the tank are $2' - 4\frac{1}{2}''$ long and 1 ft. broad. A $4\frac{1}{2}''$ wall in the middle of the tank should be so built that it is $6''$ high towards the inlet of water and $5''$ towards the other. This wall will divide the tank into two tanks each $1' \times 1'$.

In the tank, other than the one in which water falls, leave a space of $2\frac{1}{2}''$ to $3''$ from the bottom and make a groove of $9''$ to $9\frac{1}{2}''$ in both the walls. Fit in a plank in this groove. Three or four inches above the bottom fix a pipe for the outlet of water into the soakage channel.

Before using the sullage tank a $4''$ to $5''$ thick layer of grass and leaves etc. should be placed in the portion over which the plank has been fixed. Ashes, mud, coal and oily substances in the waste water are blocked here and settle down in the tank. The water flows over the wall in the middle and goes to the other tank. Floating substances like charcoal, oils etc., are intercepted by grass and leaves at this place. Because of the plank, the water flows through the grass and leaves etc. in this and the second tank and goes into the channel. This water is well cleaned.

The sullage collected in the sullage tank should be taken out by a spade. Grass and leaves etc. should also be removed and fresh ones placed. Some times lime and gamaxine should be sprinkled in the refuse tank so that insects may not breed. Do not use phenyle, dettol or D.D.T. A container with holes in the bottom can also be used in the refuse tank so that if necessary it can be taken out, cleaned and replaced in the tank.

If lot of water is used then an extra tank should be built with a plank over it as in the other tank for further cleaning of water. The refuse tank can be built big or small according to the quantity of water used.

If the channel is long, smaller tanks may be constructed or coloured containers kept in the passage to intercept the sullage, mud etc. If the soakage channel is far from the sullage tank then also tanks should be built in between.

Soakage channel

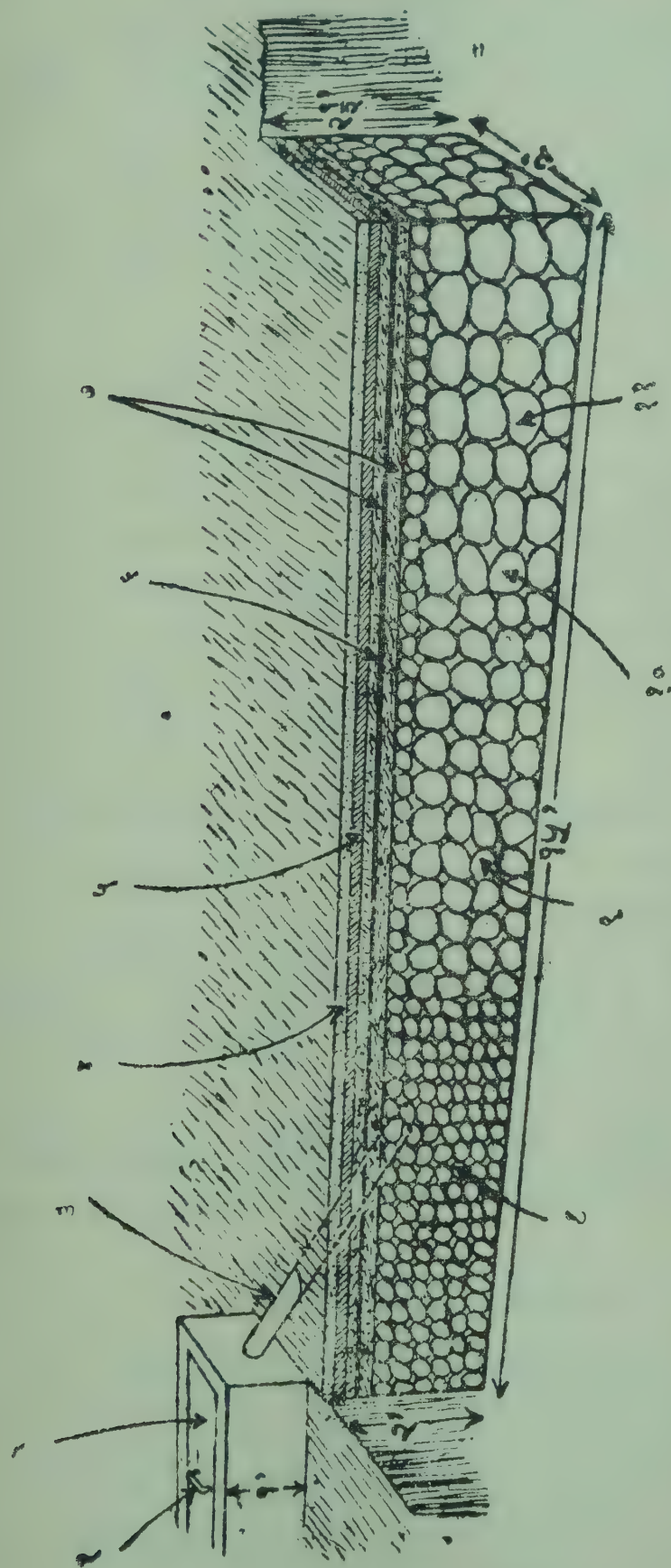
Where a large volume of water is used, the soakage pit is not of much use. Soakage channel is built where more than 50-60 buckets of water is used.

Construction

Dig a channel 15 ft. long and 2' broad. It should be 2 ft. deep in the first portion and 2'—6" in the last portion. It should be divided into three chambers of 5 ft. each. The first chamber should be filled with round pabbles of 3"—4" diameter leaving a space of 9" at the top. In the second portion round pebbles of 4"—5" diameter and in the last those of 5"—6" diameter should be placed. After this a 3" thick layer of pebbles of 3"—4" diameter should be laid throughout. The outlet pipe from the sullage pit should be fixed on the side of the smaller pebbles.

The soakage channel is covered from above in the same way as the soakage pit. A 1" layer of vegetable matter which does not decompose should be laid over the stones in

the channel. Gunny cloth should be used to cover it so that mud and refuse etc. may not get in. Again a similar layer of undecomposable vegetation should be laid and coated with 1" layer of mud. Then put dry earth over it so that its level may



Soakage channel

1. Handle of the cover. 2. Cover over the sullage tank. 3. Pipe to let water into the soakage channel. 4. Small pieces of bricks. 5. Wet mud as mortar. 6. A piece of gunny cloth. 7. A layer of vegetation that does not decompose. 8. Round pebbles of 3" to 4" diameter in the 5 ft. portion. 9. Round pebbles of 4" to 5" in the second 5 ft. portion. 10. Round pebbles of 5" to 6" diameter in the third 5 ft. portion and a layer of pebbles of 3" to 4" diameter over the whole. 11. Undergrround soakage channel.

be 6" above ground level. Gradually this earth will get pressed and be level with the ground. Carts and trucks can

pass over the soakage channel without causing any damage to it.

How to Use

Stone pieces should be well cleaned before putting them in the soakage channel. Take care that earth does not fall in it. The pit should be cleaned before stones are laid. When the sullage tank is filled up it should be cleaned after removing the cover and grass and leaves changed with fresh ones. The sullage tank should be cleaned once or twice a month. If it is regularly cleaned as described above the soakage channel will give satisfactory service for 7 to 8 years.

The soakage channel can be made 30 ft. long and 3 ft. deep if much water is used. It should not be deeper than 3 feet although its length and breadth can be increased. If 30 ft. long space is not available then two channels each 15 ft. long can be made. These can be used alternately and thus the cycle repeated. If the soakage channel is not to be used then the clean water coming out of the sullage tank can be utilised in the garden.

After many years when the soakage channel gets filled up it should be opened and all the stone pieces taken out. The moss around the channel be removed and the channel left open for five or six days to dry. Later the stones should be washed, replaced as described above and the channel brought into use again.

In this way the waste water at public places can be allowed to flow in the soakage channels with sullage tanks and cleanliness assured.

CHAPTER XXIV

THE COMPOST PIT

There are two or three methods in vogue these days for making manure. Substances which decompose should be turned into manure. The quantity of manure available in the country is not sufficient. Chemical fertilizers have to be produced at the fertilizer factories. The proper thing to do will be to turn scientifically the human excreta, garbage, dung etc. into manure. This will remove dirt and filth and lessen the chances of epidemics and diseases. There will be less flies and waste matter will turn into useful manure. The present day shortage of grains may also be due to shortage of manure. China and Japan have made every inch of their soil fertile by the use of human excreta.

Recently machines have been devised for preparing manure within a month. Manure houses have also come into existence for preparing manure. The garbage is suitably arranged so as to turn it into manure with the help of the bacteria in the air.

Only 30% of the dung available in India is turned into manure. That too is not prepared scientifically. The dung-heaps in the villages lose their nitrogen due to rain and sun. Proper pits should be made for manure. 40% of dung is baked for fuel and 30% goes waste because it lies at unsuitable places.

Manure from Dung and Garbage

For making manure from dung of 2 to 5 heads of cattle and garbage, a pit $10' \times 6' \times 3'$ should be dug. The earth at the edges should be kept $1\frac{1}{2}'$ to $2'$ away so that rain water may not go into the pit.

Upto a height of 1 ft. the pit should be filled up with waste grass and leaves, garbage and dung. A mixture of dung with two-three canisters of water should then be sprinkled over it. The process should be repeated until the level of the garbage is 2 ft. higher than the ground level. The pit should then be closed with earth. The manure will be ready in three or four months. It should be taken out of the pit, heaped by its side and covered with earth. It can also be directly used in the farm.

The pit should not be deeper than 3' or $3\frac{1}{2}'$ or broader than 8'. Aerobic bacteria which live on air can remain alive only upto 3 ft. below ground level. They grow upto 3' only when in contact with earth. Hence the pit should not be broader than 6'. This breadth will be convenient in taking out manure as well as in putting dung and garbage in it. Its length can be increased according to the number of cattleheads and space. It can also be divided into two.

Benefits of Compost-Pit

- (1) By filling the pit in this way flies do not breed.
- (2) By decomposition of organic substances in the pit, the nitrogen remains intact.
- (3) Because of considerable heat the compost decomposes well.
- (4) By proper filling of the pit there is not much heat inside it.
- (5) Seeds of superfluous plants die out and do not grow again.
- (6) Waste matter and garbage is usefully employed and waste is turned into gold.
- (7) A minimum distance of 8' should be kept between the two pits.

Manure from Garbage and Faeces

In this country much attention is not paid towards preparation of manure from faeces. Where service-latrines exist,

it is essential to make manure from faeces. Faeces are obtained at the rate of 8 to 14 oz per head. In this country, almost 50% of houses have no latrines. Sometimes some of the faeces cleaned from latrines is flown down the gutter. Sometimes it remains lying in the latrines, which is devoured by pigs where they exist. Garbage in the towns lies here and there and it is not turned into manure. Manure is formed from 30% to 40% of garbage. The garbage contains 20% to 30% of inorganic matter which does not decompose and this has to be separated.

In India, there are 3,100 towns with a population of more than 5,000. These towns have a population of 7.88 crores. It is important to make arrangements for turning the faeces and refuse of so many persons into manure. The garbage and faeces of a population of this magnitude can yield 90 lac tons of manure, but at present only 28.55 lac tons are obtained. If the entire is turned into manure it can provide 0.61 lac tons of nitrogen, 52 lac tons of phosphoric acid and 0.71 lac tons of potash which are worth Rs. 25 crores. It would come to manure worth about Rs. 4/- per head. This would remove the filth and diseases and also bring revenue. It will also considerably boost agricultural production.

It is important to give training in the method of preparation of manure and provide facilities to workers at compost centres.

In many provinces, people do not utilise manure made from faeces while in many others much income is derived. Bengal, Panjab, Maharashtra and Saurashtra have considerable income from manure.

Method of Preparation of Manure

In 1920, Hutchinson and Richards started the preparation of manure by scientific method in Rothenstead.

In India the Bangalore and Indore methods of preparation of manure from faeces and garbage was started by Municipalities.

In the pit, a 6" thick layer of garbage is placed over which a 2" layer of faeces is spread. This is followed by another 9" layer of garbage with a 2" layer of faeces over it. Such layers are arranged till the pit is full. The garbage is filled upto a level two feet higher than the ground level. It goes on subsiding gradually by pressure. Within a week the temperature rises upto 60° C and in six months good manure is ready.

Scientific Method of Preparation of Manure

Human excreta is an organic substance which contains proteins and carbohydrates (starch). Protein contains carbon-dioxide and nitrogen. The soil requires much nitrogen which it absorbs from the air also. This, however, is in very small quantity. The soil has lot of bacteria which live on the carbon of organic matter. Carbon and nitrogen are in the ratio of 60:1 in the human excreta. Bacteria in the soil eat the carbon and reduce this ratio to 12:1. In the process of preparing manure from garbage, the bacteria take carbon indirectly from faeces in the form of carbon-compounds. The carbonic compounds thus digested in the soil are called Humous. They are sort of a nitrogen-bank from which the soil slowly draws nitrogen as required.

The aerobic bacteria in the soil destroy the disease-spreading pathogenic bacteria. At a particular temperature and humidity of the soil the disease-bearing germs get destroyed.

In order to destroy the disease-carrying germs, the faeces should be dumped in the pit as stated. After filling the garbage, gamaxine should be sprinkled by a hand pump over it so that flies may not breed.

Necessary Information

- (1) In a village having a population of 5,000 persons, 125 cu.ft. of garbage is produced daily. This gives 500 tons of manure yearly.

- (2) A population of 10,000 produces 250 cu. ft. of garbage for which 200 pits are required for the year.
- (3) 120 pits of $15' \times 5' \times 2\frac{1}{2}'$ can be made in an area of one acre.
- (4) For the preparation of 500 tons (25,000 cu.ft.) of manure one acre of land is required.

<i>Population</i>	<i>Dimensions of the pit</i>		
	<i>Length</i>	<i>Breadth</i>	<i>Depth</i>
Less than 10,000	15 ft.	5 ft.	$2\frac{1}{2}$ ft.
10,000 to 20,000	20 ft.	6 ft.	3 ft.
20,000 to 50,000	30 ft.	7 ft.	3 ft.
Over 50,000	35 ft.	8 ft.	$3\frac{1}{2}$ ft.

There should be a distance of 8 ft. between two pits.

Value of Manure and Quantity to be Used

In this manure, organic matter is more than it is in the dung-manure. Nitrogen and phosphoric acid are twice as much as in the dung-manure.

One ton comprises two cartloads. It contains 15 to 20 pounds of nitrogen, 12 to 15 pounds of phosphoric acid 300 to 400 pounds of organic matter.

Quantity of Manure to be Used

In an acre of crop like those of vegetables, sugarcane and rice etc., 15 to 20 cartloads i.e. 10 tons of manure should be used. Where the rain-fall is 20" to 25", add 5 to 10 cartloads of manure per acre. Where the rainfall is less put 3 to 5 cartloads of manure per acre.

Provision at Manure Centres

Along with the dirt and filth of the entire town, disease-carrying germs are also imported. Therefore, care must be taken when manure is prepared from such garbage and night-soil. Suitable facilities should be provided to workers put on this job. They should be supplied with shoes for the protection of their feet, complete uniform and shovel as well as fork for handling refuse and garbage.

The compost centres should be located at least 3—4 furlongs away from the town. Provision of sufficient water for bathing and drinking for the workers should be made at these centres. Arrangements should also be made so that they may rest at noon, if they like, after washing their hands and feet.

There should be a shed and small room at the manure centre. A room is also necessary for keeping the implements and for resting at noon or taking shelter from rain. A first-aid box should also be provided there.

It will be better if arrangements are also made for washing trailers, tankers, buckets etc.

The manure centres should be kept neat and clean. The paths should be well laid. The pits which are closed should bear plates showing the relevant dates.

Undecomposeable things should be taken out and heaped at one place. Pieces of bricks can be used for paving paths. Tin and glass pieces can be sold once a year.

Thus, separating undecomposeable matter enhances the value of the manure. The waste articles can be put to some other use. One person can sift 100 cu. ft. of refuse and garbage and fill it in the pit in one day.

It is necessary to have a wire fencing at the compost centre. Trees can also be planted around it. The expenditure of this centre can be met from the sale proceeds of manure.

APPENDIX—I

I. Standards for Providing Staff and Implements for Cleanliness in Towns

(i) BASIS FOR MEANS OF CLEANLINESS

- (a) Seat (of the latrine) (b) Towns having service latrines.

A person takes 5 minutes to ease himself and it takes $2\frac{1}{2}$ minutes to clean the faeces from the pot. In all, a person uses a latrine for $7\frac{1}{2}$ minutes. Generally a latrine is used for three hours in the morning and approximately the same number of persons use it in the evening. Hence the number of persons using the latrine in the evening is not assessed. On this basis, one seat is necessary for 20—24 persons.

(ii) TOWNS WITH SANITARY (FLUSH TYPE) LATRINES

There is no problem of cleaning of faeces pot. Therefore one seat (latrine) can serve 36 persons.

(iii) TOWNS WITH SEWERAGE AND WITHOUT SEWERAGE

(A) The entire town cannot be taken into consideration for providing latrines because some parts abound in private latrines and others do not. The houses which are provided with latrines should be counted and the number multiplied by 5 to arrive at approximate population. By deducting this number from the total population of the town an estimate of the number of persons for whom public latrines are required can be formed. In this way the number of latrines required for areas with sewerage and those without sewerage can be ascertained.

(B) *Urinals*

For every 300 members of the population there should be one urinal. Their situation at places where they are specifically required should be fixed.

(C) *Bullock-cart for Conveyance of Faeces*

The sewered areas do not require bullock-carts for transporting faeces because in such areas places for collection of flushed faeces are fixed. Areas without sewerage usually have separate places for collection of solid and liquid matter. Liquid contents including the urine and some water used for ablution goes down the drain or into the soakage pits. The only remaining problem is that of ash and faeces mixed with water of ablution. Eight ounces of faeces per head per day are produced. One cu. ft. of faeces consisting of some ash and water of ablution weighs nearly 60 pounds. Thus faeces of one thousand persons will be 8 cu. ft. Hence the number of trolley type conveyance for faeces and trucks can be estimated on the basis of the weight of the faeces and the number of persons. A trolley type conveyance whose internal capacity is 12 cu. ft. can hold 75 gallons of liquid or semi-solid matter. Such a conveyance can carry 24 cu. ft. of faeces in two trips to the manure centre. On this basis seven carts of this type will be sufficient for a population of 20,000.

For carrying faeces mixed with ash, generally, garbage carts with covers are used. If the capacity of such a cart is 30 cu. ft. and it makes two trips to the manure centre per day, it can transport 60 cu. ft. of faeces. Thus a cart of this type can serve the purpose of a population of 7,200 persons.

If a faeces-carrying vehicle with a capacity of 120 cu. ft., makes three trips to the manure centre, it can transport 360 cu. ft. of faeces. Therefore a truck of this type can serve a population of 43,200 persons. Thus one such truck can be used in place of 6 carts of 30 cu. ft. capacity each.

A truck with a capacity of 150 cu. ft. which makes three rounds per day can serve a population of 54,000 persons and can be used in place of $7\frac{1}{2}$ carts of 30 cu. ft. capacity each.

Similarly a truck of 120 cu. ft. capacity which can make 4 rounds can be used in place of 10 carts of 10 cu. ft. capacity each for this purpose.

(D) *Refuse Carts*

Ten ounces of garbage is received per head per day. 1 cu. ft. of it is 20 pounds in weight. A cart with a capacity of 30 cu. ft. which makes two trips per day to the compost centre can transport 60 cu. ft. of garbage and can thus serve the need of 1,920 or roughly 2,000 persons. A truck with a capacity of 150 cu. ft. making 3 rounds per day can transport 450 cu. ft. of waste and garbage. It can, therefore, serve a population of 14,500 persons. Such one truck can replace 7 carts of 30 cu. ft. capacity. If the truck can make four rounds, it can then serve the need of 19,200 persons and can replace 10 garbage carts of 30 cu. ft. capacity each.

Trailers drawn by tractors are now being increasingly used for transport of faeces and waste etc. The number of people who can be served by such trailers will depend on their capacity and the number of trips they make to the compost centre. On the basis of the above, the number of tractors and trailers required for a town can be calculated.

(E) *Wheel-Barrow for Faeces*

A sweeper cleaning latrines should be provided with a wheel-barrow.

(F) *Garbage Cart*

These carts are not required for sewered areas. In towns having service type latrines the number of such carts will depend upon the number of gutters in existence. If there are open gutters everywhere, garbage carts will not be necessary. A cart has a capacity of 75 gallons or 12 cu. ft. The number of such carts depends on the number of waste baskets to be cleared and the number of trips each cart would make.

The quantity of garbage in each waste basket and how many trips a cart has to make should be estimated. The

number of trips would depend upon the distance between the collection and dumping centres and the condition of roads. Implements for cleaning gutters can also be used. Saving is possible by the use of double size carts which can carry three times as much garbage. It requires one driver and one filler instead of three drivers and three fillers necessary to man three smaller carts. A double-size cart can be recommended for a place accessible by metalled road. A cart of this size is sufficient for 1,000 to 1,500 persons.

(G) *Carts for Transporting Wet Garbage from Underground Gutters*

These carts are required for transporting wet garbage, ash, mud etc. which are found in underground gutters, pot-holes and houses. It is very difficult to estimate the number of these carts in areas served by sewers as it depends on local conditions e.g. the connection of sewerage with houses, density of population, flow of rain and storm water in addition to faeces etc. Two carts of 30 cu. ft. capacity each which make two trips per day should be sufficient for one mile length of the sewer. Where mechanised transport is available, a three ton truck with a capacity of 120 cu. ft. which makes two rounds per day will be equal to 8 of the above carts.

(H) *Long Broom*

This should be made of green bamboo.

Dimensions :— 350 to 400 twigs (wickers) each 2'—10" long and $\frac{1}{2}$ " to $\frac{1}{8}$ " thick. Each broom should be 1 seer in weight. It can be used for three months. It would be better if the broom is fitted with a 4½' to 5' long bamboo stick so that the sweeper may not have to bend his back while working.

(I) *'Panja (Claw)*

This is made of 16 gauge iron sheet (0.0625" or $\frac{1}{2}$ gauge thickness). It should be 24" long and 3" broad. Its weight should be about 10 chhataks. This will serve for about 6 months.

(J) *Spade*

The blade should be of 8 guage (or 0.125" gauge) iron sheet. It should be semicircular in shape. The radius of the circle should be 11" and perpendicular distance between the centre and the end should be 7". It will weigh approximately one seer. This blade is attached to a holder which is of iron. The holder should not weigh less than 12 chhataks. It should be 5" long and $1\frac{3}{4}$ " broad. It should have a hole of $1\frac{1}{2}$ " in which the handle can be fixed. It should be rivetted to the blade with 3 rivets of $\frac{3}{8}$ " size. The total weight of a spade of this type is 1 seer and 13 chhataks and it lasts for a year or so depending on the way it is used.

(K) *Small Basket*

Sweepers should be provided with small baskets which should weigh 2 seers each. They generally last for 1 month.

(L) For cleaning of sewers a particular type of stick is used. A set of these sticks should be provided to every group of workers.

(M) Enough covers should be provided for removal of garbage, preventing faeces from spreading in lorries and screening the revolting sight from public gaze.

(N) *Protective clothing*

In the hills, sweepers should be given gum-boots, jerseys, socks, and rain-coats. In the plains they should be provided with rain-coats in the rainy season.

(O) The fillers of garbage and faeces and beldars at collection centres should also be given shoes.

(P) Dimensions and weights of B.S.S. 792 containers.

N.B. These containers should be of tinned steel. It will be better if the containers are first made, according to specifications, of black sheets and then tinned.

Capacity	Internal Height	Internal diameter of top	Internal diameter of bottom	Thickness of bulging edges	Main Part	Bottom	Cover	Bottom	Specified weight after tinning
1 cu. ft.	14"	14"	12"	1½"	24 B.G.	22	24	18	13 Pounds
2 cu. ft.	20"	16"	14"	2"	22 "	22	24	18	20 —do—
2½ cu. ft.	22"	17"	18"		22 "	22	24	16	23 —do—
3¼ cu. ft.	24"	16"	16"	2½"	22 "	20	22	16	18 —do—

II Staff Requirements

India

(1) SET OF PUBLIC LATRINES

(A) *Areas with Provision of Water*

One sweepress is sufficient for a set of 24 latrines. For a set of 24 to 48 latrines one sweeper and one sweepress i.e. two persons should be appointed.

(B) *Areas without Provision of Water*

A sweepress can clean 10 latrines per day. For a set of twenty latrines one sweeper and one sweepress should be appointed.

(2) ROADS AND LANES WITH GUTTERS ON BOTH SIDES

A sweeper can clean 13,000 sq. ft. of road or space and 1,300 ft. of gutter of normal size.

(3) ROADS AND LANES WITHOUT GUTTERS

One sweeper can clean 20,000 sq. ft. of road in a densely populated area and 50,000 sq. ft. in a sparsely populated or unpopulated area.

(4) GUTTERS

One sweeper can clean 2,000 to 3,000 ft. of gutters of normal size. If there is no mechanical arrangement for supply of water, one waterman will be required for supplying water in areas with or without pipes.

(5) REMOVAL OF GARBAGE AND FILTH

One driver is needed for a truck of 30 cu. ft. capacity. For removal of garbage by lorry one cleaner, one driver and four workers for loading will be needed.

(6) REMOVAL OF FAECES

One driver is needed for one truck. There is no need for workmen for loading. For a lorry carrying faeces, one driver, one cleaner and four workers are required.

(7) GARBAGE TRUCK

One driver is required for one truck. The number of workmen required is the same as under item (6).

(8) GARBAGE COLLECTION CENTRE

For a lorry making four rounds one workman is required for covering the manure.

(9) DIGGING DEEP PITS

One workman is required for two trucks.

(10) UNDERGROUND SEWER

Three sweepers can clean one to two manholes per day.

(11) TRUCKS FOR WET GARBAGE

For one truck, one driver and one workman for loading are required. For lorries also the same standard applies as for garbage carts.

(12) BUCKET DEPOTS

For one bucket depot, one workman is required.

(13) RUBBING PITS

For every twelve pits, one driver for truck and four workmen are required.

(14) SLAUGHTER-HOUSE

Every municipality usually has two slaughter-houses one for cows and buffaloes and the other for goats and sheep. If 100-150 heads of cattle are killed then one sweeper and one waterman is required. For the remaining filth one truck with driver is required. Double the number of workers is required if the number of cattle-heads is between 151-300.

(15) DOG-CATCHING

For a town of 30,000 population, one truck, one driver and two dog-catchers are required. They can be used for lifting carcasses from roads also.

(16) JAMADARS

One jamadar and one assistant jamadar can supervise the work of 25 sweepers.

(17) A 10% reserve-staff should be provided on the total number of workers.

APPENDIX—II

SURVEY PROFORMA

1. Name of town.....Tehsil.....District.....
2. Population.....
3. Area.....Number of habitable houses.....
4. Total income of the municipality.....
5. Expenditure on cleanlinessIncome from manure (compost).....
6. Number of gallons of water provided per head.....
7. Length of drainage.....Pucca.....Kachcha
8. Number of sweeper families.....
9. Total population of sweepers.....men.....women.....
10. Number of workers for cleanliness in the municipality :
men.....women.....total.....
 - (i) Workers for cleaning of latrines.....
 - (ii) Workers for cleaning of roads.....
 - (iii) Workers for garbage removal.....
 - (iv) Workers for faeces depot.....
 - (v) Workers on faeces trucks.....
 - (vi) Workers for cleaning of gutters.....
 - (vii) Workers for miscellaneous work.....
11. Number of sweepers men and women employed on jobs other than cleanliness :
 - (i) Under the municipality.....
 - (ii) In other vocations.....

Educational Position

1. Number of school-going children.....

	Boys	Girls	Total
Primary			
Middle			
Higher Secondary			
Colleges			
Industrial			
2. Number of boys and girls residing in hostels.....
3. Boys and girls of school-going age (6 to 10 years).....
4. Is there a children's home ?.....
 - (a) Who runs this home ?.....
 - (b) Where from financial help is received ?.....
 - (c) Number of sweepers' children in the home.....
5. Cultural activities in the sweepers' colony :—

Activity	Organising Body
1.	1.
2.	2.
3.	3.

Housing Arrangement

1. Number of sweepers' colonies.....
2. Number of families living in their own houses.....
3. Number of families living in rented houses.....
4. Number of families living in quarters provided by the municipality.....
5. Are there housing societies ?.....
6. What is the arrangement for drinking Water ?.....
 Period for which water is available.....What is the
 arrangements for lighting ?.....Arrangements for
 latrines.....their number.....Are there bath-
 rooms ?.....

Economic

1. Who runs the credit society ?.....
 - Number of members.....
 - Amount of share capital.....
 - Date of establishment of the society.....
2. Scale of pay of workers.....

Arrangements for Cleanliness

1. Number of public latrines.....
 - (i) Septic tank..... (ii) Aqua privy (water-borne latrines).....
 - (iii) Dry type service latrines.....
 - (iv) Water seal.....
2. Is there provision of water near the latrines or not ?.....
3. Number of latrines cleaned privately.....service type..... non-service type.....
4. Information about the condition of private latrines.....
5. What is the arrangement for transport of faeces (from the latrine to the dumping ground).....
6. Scavenging tax.....
7. Number of wheel-barrows.....in use.....out of use.....
8. Type of wheel-barrows.....
9. Number of faeces depots.....
10. Distance of the faeces depot.....
11. Number of vehicles for transport of faeces :
 - (1) Bullock-cart.....
 - (2) Trailer with truck.....
 - (3) Tanker with truck.....
12. Distance of the dumping ground from the town.....
13. In what direction it is situated ?.....
14. Number of compost pits
15. Method of making compost.....

16. What is the arrangement for washing of wheel barrows and faeces carts ?.....
17. What is alternative arrangement for washing if none is made by the municipality.....
18. Number of urinals.....
19. How many implements of cleanliness are in use ?.....
 - (1) Scraper (for lifting faeces).....
 - (2) Scraper for picking up garbage.....
 - (3) Upright broom.....
 - (4) Hand cart for removal of garbage.....
 - (5) What is the device for unloading garbage from the cart ?.....
 - (6) How many garbage trailers are available ?.....
 - (7) Tractors.....
 - (8) Trucks.....
 - (9) Bullock-carts.....

What work and amenities are provided by the municipality to the workers ?

1. How many uniforms a year are given ?.....In what month uniforms are issued ?.....
2. What clothes are given as winter uniform ?.....Are rain-coats given ?.....
3. Gum-boots.....
4. Hand gloves.....
5. House-rent.....
6. Washing allowance.....
7. Soap.....
8. How many holidays are given in a year ?.....
 - (i) Sick leave..... (ii) Casual..... (iii) Maternity leave..... (iv) Earned leave..... (v) Weekly..... (vi) Festival.....
9. Number of relieving staff.....
10. Number of permanent staff.....

11. Number of temporary staff.....
12. Is provident fund deducted ?.....
13. Whether pension or gratuity is given ?.....
14. Is there a fine-fund ?.....What amount is in the fund ?.....
15. To what use is the fine-fund put ?.....
16. How many running feet are entrusted to sweeper for cleaning ?.....
 (i) in densely populated area..... (ii) in sparsely populated area.....
17. How many latrines are given to the sweeper for cleaning :—
 (i) Private..... (ii) Public.....
18. How many running feet of gutter for cleaning ?.....
19. How many workers are on a truck for loading garbage ?.....
20. How many families have benefitted from family planning ?.....
21. Is there any store for utility goods for sweepers ? (Brief description).....
 Who manages it ?.....
22. Is there a committee for development of home industries ? (Brief description).....
 Who runs it ?.....

Note :—What means of transport are used for carrying faeces from the latrine to the dumping ground. The worker should himself write after verification.

APPENDIX—III NECESSARY INFORMATION

(1)

- 1 mile=1760 yards
- 1 mile=5280 feet
- 1 foot=30.50 centimeters
- 1 meter=3.28 ft.
- 1 inch=2.54 centimeters
- 1 Sq. inch=6.45 Sq. centimeters
- 1 Sq. foot=144 Sq. inches
- 1 Sq. meter=10.8 Sq. feet
- 1 Imperial gallon=10 pounds in weight
- 1 Cu. Foot of water=62.4 Pounds
- 1 Litre=61.02 Cu. inches
- 1 Litre=0.220 Imperial gallon
- 1 Ton=2,240 Pounds
- 1 Pound=454 grams

(2)

- 1 Brass= $10' \times 10' \times 1' = 100$ Cu. ft.
- 1 Bag cement= $1\frac{1}{4}$ Cu. ft.=112 Pounds in weight
- 1 brass bricks=1200 bricks
- 1 brass sand=30 cu. ft.

Cement Ratios

- 1 : 6 mortar for one brass of work=5 bags of cement
- 1 : 5 mortar for one brass of work=6 bags of cement
- 1 : 3 plaster in 100 cu. ft.=2 bags of cement
- 1 : 3 pointing= $\frac{3}{4}$ bags of cement

Cement Concrete Ratios

- 1 : 4 : 8 in one brass of work=8 bags of cement
- 1 : 8 : 16 in one brass of work=4 bags of cement

1 : 5 : 10 in one brass of work = 6 bags of cement

R.C.C. slab in 100 cu. ft. = 16 bags of cement

(3)

$$\text{Circumference} = \text{radius} \times 2 \times \frac{22}{7}$$

$$\text{Area of a round well} = \pi \frac{\text{diameter}^2}{4}$$

$$\text{Area of surface of a round well} = \frac{22}{7} \times (\text{radius})^2 \times \text{height}$$

$$\text{Conical shaped well} = \frac{2}{3} \times \pi \times \text{radius} \times \text{height}$$

(4)

Water

- (a) Quantity of water = $D^2 \times W^2 \times 5$ = water in gallons
when D = Diameter of well, W = Depth of water
- (b) For purifying water add 1 Oz of potassium permanganate in 1000 gallons of water
- (c) The following amount of water is required per head per day :—

1. For drinking	0.35 gallon
2. For cooking	0.65 gallon
3. For bathing and washing	8.00 gallons
4. For cleaning the house	3.00 gallons
5. For washing of clothes	3.00 gallons
6. For latrine and urinal	5.00 gallons
<hr/>	
Total	20.00 gallons

(5)

1 cu. ft. garbage	= 20 pounds in weight
1 cu. ft. faeces	= 60 —do—
1 gallon faeces	= 10 —do—
1 cu. ft. manure	= 40 —do—

(6)

Components of Faeces (from the point of manure)

1. Water	72.2%
2. Organic matter	19.8%
3. Nitrogen	1½%—2%
4. Phosphorous	1.1%
5. Potash	0.25%
6. Lime	0.62%
7. Magnesium	0.36%

Characteristics of Mature Manure

Black, Light and Soft.

Components of Human Urine

Water	15%	Magnesium	0.006%
Protein	0%	Chloride	0.06%
Glucose	0%	Inorganic phosphate	0.27%
Urea	2%	Inorganic sulphate	0.18%
Uric acid	.05%	Other substances	1.944%
Potassium	0.15%	(Sodium)	
Ammoniam	0.04%		

APPENDIX—IV
REFERENCE BOOKS

1. Clean People and an Unclean Country.
2. Rural Latrine Programmes.
3. A Text Book of Sanitary Engineering.
4. Sewrage and Sewage Treatment.
5. Excreta Disposal for Rural Areas and Small Communities.
6. Faeces and Waste-Water Disposal.
7. Urban Latrines (conservancy type) and Public Latrines.
8. Copies of 'Safai Darshan' Magazine.
9. Cleanliness (Science and Art).
10. Composting.
11. Scavengers' Working Conditions Enquiry Committees Report 1958.
12. Manual of Public Health.

